AN ANALYSIS OF ALTERNATIVE NETWORK ELEMENTS AVAILABLE TO CLECS

Prepared by Network Engineering Consultants, Inc.
Under the Direction of Francis J. Murphy, President
May 26, 1999

I. Executive Summary

This paper presents an analysis of the alternative sources of network elements available to the increasing number of Competitive Local Exchange Carriers (CLECs) providing telecommunications services. Since 1996, the number of CLECs has grown by 400%, from 200 to 1000.[1] Today, in most major markets in the United States, as well as in many smaller markets, CLECs are providing telecommunications services with little or no reliance on the network functionality of the Incumbent Local Exchange Carriers (ILECs). CLECs are providing their own switching, transport facilities and local loops. In addition, they are securing Signaling System 7 (SS7), Operations Support System (OSS), and Operator Services and Directory Assistance functionality from non-ILEC sources. In areas where they do not provide their own facilities, they are opting to purchase network elements from wholesale providers rather than ILECs. The information presented in this report demonstrates that CLECs have been and will continue to be able to successfully expand their networks and corresponding customer bases without relying on ILEC-provided network elements.

II. Analysis of Switching Alternatives Available to CLECs

A. CLECs Are Providing Their Own Switching Functionality

Today, in most major markets in the United States, there are many CLECs providing their own switching functionality, rather than purchasing it on an unbundled basis from an ILEC. CLECs are opting to build their own switching networks because it affords them more control, more flexibility, and better planning capability. Self-provisioning also allows CLECs to choose between various technologies and to be knowledgeable at all times about the available capacity of their facilities. The matrices below detail a sample of CLECs that are providing their own switching functionality, the technology and vendors they are using, and the ranking Metropolitan Statistical Areas (MSAs) where their switches are located.[2] These matrices contain only a sample of the companies that are opting to

[1] See Attachment A.(Chart presented by Jeff Phillips, Consultant, TeleChoice, Inc. at a 3Coms=s Starting Ahead, Staying Ahead Seminar in Boston, Mass. (February 4,1999)).

[2] For purposes of this analysis, the ranking MSA are those identified by the United States Bureau of Census. See Attachment B (U.S. Bureau of Census, *AState and Metropolitan Area Data Book 1997-1998,*

provide their own facilities, but even this small sample demonstrates that all types of CLECs are providing their own switching capabilities throughout the country -- in both large and small markets.

1. Traditional CLECs Are Providing Their Own Switching Functionality

Traditional CLECs are providing their own switching functionality in markets throughout the United States. For purposes of this paper, traditional CLECs are defined as telecommunications service providers that provide local service to end users over a circuit-switched network in a manner similar to the way ILECs provide service. These CLECs are taking advantage of the numerous switching options available from switch vendors specifically catering to the CLEC market. Various types and sizes of switches with a broad range of functions, feature options, and prices are available from an ever-increasing number of switch manufacturers. As Table 1 below demonstrates, traditional CLECs are providing their own switching capability in most major MSAs, as well as in many smaller MSAs.

TABLE 1: SELECTED TRADITIONAL CLECs PROVIDING THEIR OWN SWITCH FACILITIES

CLEC	**TECHNOLOGY/ VENDOR**	**MSA RANK OF SWITCH LOCATIONS ( )= # of switches**
21st Century Telecom Group	Siemens EWSD	3
Allegiance Telecom	Lucent 5ESS AnyMedia, Nortel DMS 500	1 (3 switches), 2, 3, 4, 6, 7, 9(2), 11
AT&T	Lucent 5ESS, Nortel DMS100	1 (11), 2 (3), 3 (6), 4 (6), 5 (2), 6 (5), 7(2), 8(2), 9 (2), 10, 11 (3), 12, 13 (2), 14,15 (2), 16 (2), 17, 18(2), 20(2), 21, 22, 23, 24 (2), 26, 28 (2), 29, 32, 35 (3), 37, 39, 45, 48, 51, 53, 61,

(5th Edition) A Statistical Abstract Supplement,≅) (April 1998)). There are a total of 254 MSAs, with No. 1 being the largest.

TABLE 1: SELECTED TRADITIONAL CLECs PROVIDING THEIR OWN SWITCH FACILITIES		
		62, 63, 65, 70, 71, 72, 75, 79, 88, 93, 95, 137
Bay Ring Communications	Class 5 Digital Switch	7
Birch Telecom	Lucent 5ESS	18
Business Telecom, Inc.	Lucent 5ESS 2000	11, 30, 37 (2), 44, 52, 79
CapRock Communications	DMS-10, DMS 500	10,127
Electric Lightwave, Inc.	Nortel DMS500, Ascend ATM, B-STDX 9000	13, 15, 23, 35, 95, 103
e-Spire	Lucent 5ESS 2000, Newbridge Main Street, Xpress ATM,	4 (2), 11, 12, 21, 24 (2), 28, 33, 34, 48 (2), 52, 53, 57, 62, 80
FirstWorld	Lucent 5ESS, Nortel DMS 500	2 (2), 5
Florida Digital	Nortel DMS500	12
Focal Communications	Nortel DMS 500, AccessNode Express	1 (3), 2, 3 (2), 4, 5, 6 (2), 7, 8
Frontier Communications	Nortel DMS 500,	1 (2), 2, 3, 4 (2), 7 (2), 9, 11, 13, 14, 16, 18, 20, 26
GCI of Alaska (General Communications)	Nortel DMS100, 105, Nortel Remote Sw. Ctr.	141 (3)
GST Telecommunications	Nortel DMS500, AccessNode Express	2 (4), 5 (2), 9, 10, 13,15, 22,55 (4), 56, 62, 64, 95, 103
Hyperion Communications	Lucent 5ESS	1, 6, 36, 38, 48, 65, 66, 71, 72, 75, 93, 107, 168, 198, 217
ICG Telecom	Lucent 5ESS	5, 9, 10, 11, 14, 20 (2), 32, 38, 42, 48, 53, 101
Intermedia Communications, Inc.	Nortel DMS100	1, 2, 3, 4 (3), 6, 7, 9, 11 (2), 12, 14, 16, 18, 21 (2), 23 (2), 29 (2), 30

TABLE 1: SELECTED TRADITIONAL CLECs PROVIDING THEIR OWN SWITCH FACILITIES		
		(2), 33, 38, 43 (3), 44, 47, 53
ITC DeltaCom	Nortel DMS500, Ascend ATM	10 Southern states with 80 POPs.
KMC Telecom Corp.	Lucent 5ESS Anymedia	8, 16, 27, 37, 71, 74, 81, 83, 85, 98, 101, 116, 131, 135, 149, 155, 183
Justice Technology	DC0	2
McLeodUSA	Nortel DMS500	29, 109, 171 and one switch in Quincy, IL
MCI WorldCom	various Nortel DMSs, Siemens EWSDs, Lucent 5ESSs.	1 (12), 2 (4), 3 (5), 4 (7), 5 (3), 6 (4), 7 (7), 8(3), 9 (3), 10, 11 (4), 12 (2), 13 (2), 14 (2), 15, 16 (3), 17, 18, 19 (2), 20, 21 (2), 23 (3), 26, 28 (2), 29, 30 (2), 35, 38, 39, 40, 43, 45, 46 (3), 47, 51, 57, 58, 62, 68, 70, 72, 73, 89, 93, 124, 125, 140
MGC Communications	Nortel DMS500	2 (2), 11, 12, 17 (2), 34, 47
New South Communications	Lucent 5ESS AnyMedia	33, 38, 52, 87
Pac-West Telecom	DEX-600E	73
PaeTec	Lucent 5ESS-2000	6, 7, 12, 54, 59
US LEC	Lucent 5ESS AnyMedia	11, 12, 27, 32, 37, 41, 44, 63, 154 (2)
TelePacific	Lucent	2
See Appendix A for table sources.		

CLECs are also providing their own switching facilities in smaller communities throughout the country, not just in the higher ranked MSAs. The table below lists several CLECs that have placed switches in smaller MSAs whose populations are very small compared to the higher ranked MSAs.

TABLE 2: SELECTED CLECs PROVIDING SWITCHES IN SMALL MSAs			
CLEC	**SWITCH LOCATION**	**MSA RANK OF SWITCH LOCATIONS**	**POPULATION OF MSA**
AT&T	Charleston, WV	137	253,850
GCI of Alaska (General Communications)	Anchorage, AK	141 (3 switches)	251,047
Hyperion Communications	State College, PA Charlottesville, VA South Burlington, VT	217 198 168	132,993 146,617 191,088
KMC Telecom Corp.	Tallahassee, FL Topeka, KS Fayetteville, NC Longview, TX Roanoke, VA	135 183 131 155 149	260,611 164,932 284,047 208,250 228,534
McLeodUSA	Cedar Rapids, IA Quincy, IL	171 not in an MSA	181,704 NA
MCI WorldCom	Portland, ME	140	251,438
See Appendix A for table sources.			

2. Cable TV Providers Are Providing Their Own Switching Functionality

Like the traditional CLECs, cable TV (CATV) providers are opting to provide their own switching functionality. In addition to CATV, CATV networks are currently being used to provide both local telephone and Internet services. Unidirectional CATV networks -- which include existing coaxial cable wiring into many homes in America -- are being updated with fiber feeder and electronics that make them two-way systems.[3] Once updated, the CATV network provides a high-bandwidth alternative to the ILEC network.

[3]CableWeb Systems Website, http://www.cable-web.com.

In addition, to complete their network build-outs, CATV companies are purchasing their own switching functionality. Companies like Cablevision, Cox Communications, RCN, MediaOne, and Time Warner Cable have placed switching facilities in major cities across the United States and are offering their customers voice-grade telephony service. For instance, Cox Communications, Inc. currently offers residential telephone service in four markets and plans to expand into the remainder of its eight major markets in the next 18 months. These markets account for more than 80 percent of Cox=s 3.4 million customers.[4] Similarly, according to AT&T Chairman C. Michael Armstrong, AT&T=s announced purchase of MediaOne Ameans that far more American consumers will have a choice in local phone service.≅[5] AT&T estimates that with the recent MediaOne purchase, it will have access to over 60% of United States households.[6] As additional mergers and partnerships are formed between CATV and telephony providers, the number of CATV companies purchasing their own switches can be expected to increase.

Table 3 below provides a sample of CATV companies that have deployed their own switches for purposes of providing voice telephony services.

TABLE 3: SELECTED CATV CLECs PROVIDING THEIR OWN SWITCH FACILITIES

CLEC	TECHNOLOGY/ VENDOR	MSA RANK OF SWITCH LOCATIONS ( ) = # switches
Cablevision Systems (Lightpath)	Lucent 5ESS	1 (2), 14
Cox Communications	Nortel DMS500	15, 17 (2), 27, 33, 39, 45, 51, 61
MediaOne	Lucent 5ESS	7, 8, 11, 16, 44, 47, 50, 56
RCN	Lucent 5ESS, Nortel DMS250	4, 7

[4]"Telecommunications Competition is Flowing,≅ by Jim Robbins, President and Chief Executive Officer of Cox Communications, Inc., Cox Commuications Website, http://www.cox.com/Corporate/Competition

[5]*AT&T offers $62 billion in cash, stock and assumed debt and preferred equity for MediaOne Group,* (April 22, 1998), http://www.att.com/press/item/0,1193,439,00.html.

[6]AT&T Website, http://www.att.com/press/item/0,1193,439,00.html.

TABLE 3: SELECTED CATV CLECs PROVIDING THEIR OWN SWITCH FACILITIES		
Time-Warner Telecom	Lucent 5ESS	1, 10, 17, 20, 23, 26, 28, 29, 30, 31, 32, 37, 40, 41, 42, 43, 54, 55
See Appendix A for table sources.		

3. Data CLECs Are Using Emerging Technology Solutions In Place Of ILEC Switching

In addition to traditional CLECs and CATV providers, carriers calling themselves Data or Packet CLECs make up a significant percentage of today=s telecommunications market. These companies -- such as Covad Communications Group, NorthPoint Communications, and Rhythms NetConnections -- focus on providing packet-switched, Internet Protocol (IP)-based data services to business customers, rather than local consumer voice service. The Data CLECs, however, are on the leading edge of an important development in the telecommunications industry -- the convergence of existing voice networks with the traditionally separate data/packet networks. This convergence is being driven by burgeoning data communication demands as well as by the constant pressure to reduce networking costs.

A key factor in this convergence is a packetized voice technology commonly known as Voice-over-IP (VoIP). In general terms, VoIP technology allows voice information to be sent in digital form by discrete data packets traversing shared virtual-circuits, rather than by the traditional circuit-committed protocols of the public switched telephone network (PSTN). A current advantage of VoIP is that it avoids the tolls charged by ordinary telephone service providers. To deploy VoIP, an enterprise positions a "VoIP device" (such as Cisco's AS5300 access server with the VoIP feature) at a gateway. The gateway receives packetized voice transmissions from users within the company and routes them to other parts of the company=s intranet (local area or wide area network) or, using a T-1 or E-1 interface, sends them over the public switched telephone network. Another significant advantage of VoIP is a reduction in network costs: Because the voice traffic shares the digital pipes that enterprise customers are purchasing to carry their data traffic, voice circuit charges are eliminated.

As these technologies mature and standards for interconnection are established, the all-digital, packet networks will replace the current circuit-switched networks. At the forefront of this convergence, Data CLECs on their own, and in partnerships with Internet Service Providers (ISPs), are beginning to offer VoIP service -- along with data, networking and Internet services -- to their enterprise customers.

Unable or unwilling to simply ignore VoIP, the established telecommunications network providers are also planning for the convergence of their existing voice and data networks. These companies agree that Asynchronous Transfer Mode (ATM) packet switching networks must be built now to support the telecommunications of the future.[7] AT&T is leading the way in building packet-switched networks. It recently

[7] Gary Kim, CLECs ToeingOIPWaters,http://www.soundingboardmag.com/articles/951feat2.html.

announced that, by the end of 1999, it would have local ATM connectivity in 41 cities nationwide.[8] These packet-switched networks will allow the equivalent of local switch technology to be moved to the end user location, thereby eliminating the need for an ILEC switch. Other existing and new companies are following AT&T's lead: MCI WorldCom, Sprint, Qwest, Level 3, and IXC Communications are all building similar networks.[9]

To meet the demand, many large switch manufacturers are currently developing VoIP and ATM switching equipment. And several companies -- including Qwest, Level 3, ICG Netcom, and IXC Communications -- have already deployed VoIP networks.[10]

4. Wireless Providers Are Providing Their Own Switching Functionality

CLECs that provide wireless telecommunications services are also opting to self-provision their own switching functionality to serve customers provisioned over wireless local loops. Table 4 below provides a synopsis of some of the fixed wireless companies that are placing their own switches rather than obtaining the functionality from ILECs or wholesale providers. These companies, who cater primarily to business customers, are providing local service by using 38 Ghz microwave technology to transport traffic from their end users to their switches. Even though Table 4 contains only a small sample of fixed wireless providers, it demonstrates that these CLECs have switching functionality in many of the major MSAs around the country.

[8] Infoworld, www.infoworld.com, March 29, 1999.

[9] Network Computing Online, http://networkcomputing.com/shared/printArticle?article=nc.

[10] *Id.*

TABLE 4: SELECTED WIRELESS CLECs PROVIDING THEIR OWN SWITCH FACILITIES		
CLEC	**TECHNOLOGY/ VENDOR**	**MSA RANK OF SWITCH LOCATIONS** **( ) = # switches**
AT&T	Lucent 5ESS, Nortel DMS100	1 (11), 2 (3), 3 (6), 4 (6), 5 (2), 6 (5), 7(2), 8(2), 9 (2), 10, 11 (3), 12, 13 (2), 14,15 (2), 16 (2), 17, 18(2), 20(2), 21, 22, 23, 24 (2), 26, 28 (2), 29, 32, 35 (3), 37, 39, 45, 48, 51, 53, 61, 62, 63, 65, 70, 71, 72, 75, 79, 88, 93, 95, 137
McLeodUSA	Nortel DMS500	29, 109, 171 and one switch in Quincy, IL
NEXTLINK	Nortel DMS 500	1,2,3,6,9,8,12,13,14(2), 95,
Teligent	Nortel DMS	1 (2), 2, 3, 4 (2), 6 (2), 7, 8, 9, 10, 11, 12, 13, 15, 20, 26, 29, 32, 39, 50
WinStar	Lucent 5ESS AnyMedia	1 (2), 2, 3, 4 (3), 5, 6, 7 (2), 8, 9 (2), 11 (2), 12 (2), 13, 14, 15, 16, 17, 18, 20, 26, 31
See Appendix A for table sources.		

5. There Are Advantages To CLECs Providing Their Own Switching

The proliferation of new switching technologies and the emergence of vendors catering to new market entrants make it possible for CLECs and other service providers to expand their networks efficiently without relying on ILECs for switching capabilities. Switch manufacturers are designing switches and integrated switching platforms to meet CLECs= specific telecommunications and market requirements. Today=s available switching platforms offer flexible architectures, modular hardware and software options, and multiple access arrangements for a variety of facility media (copper, fiber, or radio) and bandwidth (voice frequency, DS1, ATM, Ethernet, etc.). These switches offer efficient and scalable growth options for a wide range of line

and trunk requirements. Thus, CLECs need only purchase the capacity and functionality they require now, because they can easily and economically grow and expand their product line in the future without service interruptions. This flexibility, coupled with the inter-network compatibility of the available switches, has enabled many CLECs to purchase rather than lease switching facilities. And all of this has led to the growth in the portion of the switch market that specifically caters to CLECs and other alternative network providers.

A description of some of the switching alternatives available today to CLECs and other providers is found below.

a) Traditional Switch Manufacturers

In the past, traditional switch manufacturers catered primarily to the needs of ILECs. There were generally separate development paths for voice, data, and video services. Integration of services frequently was time-consuming, complex, and costly. But this is no longer the case. Traditional switch manufacturers are now courting CLECs, IXCs, CAPs, CATV, and ISPs. They are emphasizing the ability of their product lines and platforms to provide a full range of functions with the rapid, cost-effective introduction of value-added services. They are also touting their switches= scalability and capability to integrate across voice, data, and video networks. Switch manufacturers in this category include Nortel (Northern Telecom), Lucent, and Siemens, to name a few.,

Nortel DMS Systems

Nortel=s DMS-500 is a single, multi-function switching platform for both local and long distance services. It has all the features necessary for competitors to participate fully in the telecommunications market. The DMS-500 is positioned for Aemerging service providers≅ and incorporates both local and long distance capabilities. It can be configured with or without Operator Services functionality.[11]

< In its DMS-500 Sponsor Profile at www.clec.com, Nortel states: AThe DMS-500 switch uses a modular, scalable design that can meet a wide range of line and trunk size requirements and enables network providers to enter the local/long distance market by deploying an economically sized DMS-500 switch today and adding advanced capabilities later as service needs expand.≅[12]

< This scalable architecture is supported with a remote product line that ranges from the 6,400 line RSC-S, which can be located up to 650 miles from its host, to the 640-

[11] clec.com, http://www.clec.com/latest/switch98/nortel.cfm

[12] *Id.*

line OPAC, an outdoor unit that can be located up to 100 miles from its host. An additional CLEC alternative for many remote applications is the DMS Access Node, a Next Generation Digital Loop Carrier (NGDLC) device with access to switching functionality.

< Nortel=s small version of the DMS-500 product is the Super Node Size Enhanced (SNSE) model, which accommodates up to 10,000 lines. It can be upgraded to a full DMS-500, with the front-end equipment easily redeployed in another location.

< The DMS-500 is also being offered to CATV companies entering the phone business, as well as to IXCs and CAPs getting into the local service business.[13]

  < This switching system offers a hybrid network configuration for fiber and coax that is targeted to cable providers. With the Cornerstone family of access products and applications, the system delivers narrowband and broadband services to homes and businesses. It accommodates both landline and wireless architectures.

  < The DMS platform can also integrate with Competitive Access Providers= metropolitan fiber-based rings. This allows CAPs to sell a mix of local and long distance services to any size or type of business. The switch has a variety of advanced business features, which can be offered to specific customer locations or packaged for specific industries such as health care.

[13]See *U.S. Central Office Equipment Market*, (1996); *Northern Business Information* (Jan.1997); *DMS-500 CAP Product/Service Information*, Nortel website, www.nortelnetworks.com.

- With the DMS Access Node, a Next Generation Digital Loop Carrier (NGDLC) device, service providers can easily and cost-effectively reach end users and connect them with their switches. Access Nodes can be placed at the customer=s location or in collocation space. The Access Node interworks with any vendor=s fiber multiplexer. Switch features are available to customers served via the Access Node, providing additional economies of scale. On the low end, ANortel=s versatile Access Node Express is a cost-effective access solution for applications ranging from 24 to 200 lines.≅[14]

- Nortel also offers the DMS-10 (400 series) product to small service providers with minimum telecommunications requirements. It is a local digital switch that can handle 10,000 to 12,000 lines.

Lucent 5ESS-2000<7 Family of Switches

Lucent is targeting this product at CAPs, CATV operators, and IXCs as these companies enter and expand their presence in the local telephone service business, as well as at carriers deploying PCS networks. Evidencing its success in supporting these new markets, Lucent has sold switches to TCG, a competitive access provider, PCS PrimeCo, a wireless service provider, and Time Warner Cable, a CATV operator.[15]

- Lucent=s 5ESS AnyMedia Switchϑ is marketed as a multi-service, software based switch. It is designed to match the changing requirements of telecommunications service providers. It uses separate modules rather than separate switches for specific service requirements.

- The product is targeted at the same audience as the Nortel system. The system is completely scalable. It can be introduced in modules, over time, to expand the product for a full mix of voice, data, and video.

- The 5ESS comes in a variety of sizes, all with full feature functionality.

[14] *Nortel Access Node Express Product Portfolio* (May 1999).

[15] *U.S. Central Office Equipment Market* (1996); *Northern Business Information* (Jan 1997).

- The Very Compact Digital Exchange (VCXD) is the smallest switch configuration of the 5ESS-2000 product line. Lucent states in its product description: AFor Service Providers targeting small communities, rural areas and private network locations, the 5ESS-2000 VCDX offers an elegant, cost-effective solution . . . [M]ost of the features available on the 5ESS-2000 are available on the VCDX . . . [T]he VCDX can evolve into various larger configurations utilizing almost all of its existing components.≅[16]

- Next in scale is the Compact Digital Exchange (CDX) which can serve up to 37,000 lines. AWith the same features and AnyMedia functionality as the larger metropolitan switch, CDX offers you a cost effective method of delivering advanced digital services to customers in rural, suburban, campus, office parks, or other locations.≅[17]

- Both the VCDX and CDX can be initially configured for requirements significantly less than their maximum capacities.

- Remote switching modules extend the service area of the 5ESS-2000 to up to 600 miles from the host. There are a number of remote sizing options that support a wide range of smaller demand applications. The CDX also supports remotes.

Lucent=s MultiService Module builds a bridge between traditional public switched networks and data networks. It supports Internet access, Internet Telephony services, and other data services. It can easily be integrated into prior purchases in the 5ESS product family.

The 5ESS has a non-blocking line unit (Express Interface Unit) for data applications. It supports a variety of access methods including Fiber in the Loop, NGDLC, DSLAM, and xDSL.

Siemens7

The EWSD is Siemens= switching platform for call processing applications. It offers all network applications in a single node via a generic platform, including local, toll, and international gateway functions. It also supports

[16] *5ESS-2000 Switch Product Description*, Lucent Technologies Website, www. Lucent.com/netsys/5esswtch.

[17] *Id.*

Personal Communication Services. The EWSD is scalable and flexible to meet the varying needs of service providers.

< Siemens states in its product description, AEWSD offers a flexible and cost-efficient solution to meet all the requirements posed by different network structures and sizes≅.[18]

< The EWSD is supported with a line of remote switching products. These offerings include the Remote Control Unit (RCU) with capacities of 300 up to 4300 lines for small central office applications. The RCU can be located up to 600 miles from the host switch. The RCU can be upgraded to the SmartRemoteϑ discussed below.

< Siemens= planned SmartRemoteϑ will support up to 50,000 lines, but can be configured for as few as 1,500 lines. It offers full central office functionality with minimal investment in hardware. It can be used in any application where switching functionality is required. It can serve as a tandem or IXC switch as well. The SmartRemoteϑ is planned to have a capability of operating up to 3,000 miles from its host (server). This distance capability is based on the CLEC routing Long Distance traffic to an IXC rather than over the umbilical. This is a perfect application for CLECs whose serving market areas are geographically dispersed and have little or no community of interest.

< The EWSD switching platform is supported with interfaces to provide evolving voice and data services. EWSD PowerNode is a high-capacity platform for all network applications. This includes local, tandem, and toll. It supports evolution from narrowband to broadband services, and from predominantly voice services to mixed voice and data. It allows service providers to build on their existing EWSD investment in network infrastructure.

< The EWSD supports multiple access arrangements for network efficiency and economies.

< Siemens also sells the DCO Switching System as a low cost solution for CLECs. This product was originally aimed at RBOCs and

[18]Siemens EWSD Product Description Literature, *A Platform for All Call Processing Applications,* Siemens Website, http://www.siemens.de/ic/networks.

Independent Operating Companies to meet service needs in smaller suburban and rural communities.

< In a press release for the March1998 Telecom Business >98 Convention and Exposition in Dallas, Texas, Siemens Telecom Networks states the following: ASiemens= DCO switch is ideal for serving suburban and rural areas, and it provides an efficient and economical solution for competitive local exchange carriers (CLECs) seeking to enter switched, integrated services markets. Using Advanced Intelligent Network (AIN) features, service providers can offer enhanced customized features such as debit card, international call back and personalized number services.≅[19]

< In a similar press release for ALTS >98, Siemens reinforced these same points: AThe DCO switch is an ideal system for CLECs entering new markets. Cost effective, competitively priced and fully featured, the DCO switch has one of the largest remote families that support line sizes ranging from 24 to 10,000 lines.≅[20]

All of the above flexibility, coupled with the inter-network compatibility of the switches being marketed, has enabled most, if not all, CLECs to purchase rather than lease switching facilities.

b) New-Breed Switch Manufacturers

There are also companies that are supplying a different type of switching technology to the growing number of telecommunications service providers, including new CLECs and IXCs, as well as wireless and PCS providers. The switches they offer are open and programmable, so that service providers can add functions as they are needed over time. Programmable switches can work with a service provider=s current switches and proprietary software, or they can provide transport for new networks. They are often referred to as feature nodes, service nodes, or gateways.[21]

With programmable switches and open interfaces, service providers can roll out new and advanced services more quickly and cost-effectively than with traditional switches. Alliances and partnering arrangements across vendors permit easy integration of functions for voice, data, and video applications.

---

[19] *Siemens Telecom Network Demonstrates Competitive Solutions to Telecom Business >98* Siemens Press Release (March 10, 1998).

[20] Siemens Press Release, *Siemens Demonstrates Network Solutions at ALTS >98* (Nov. 30,1998).

[21] These switches generally do not provide standard Class 5 switching functionality. Instead, they are used to supplement the capabilities of circuit switches.

Customers purchase the functions and services they need, and add to them as their markets develop. A description of the features and functions available to CLECs from some of these new-breed switch manufacturers is found below.

Cisco-Summa Four

Summa Four -- now part of Cisco Systems, Inc. -- is positioned as a supplier of open, programmable, standards-based digital switching platforms. Summa Four=s products support core network functions and interfaces, as well as rapid development and deployment of new services. Summa Four=s Virtual Central Office (VCO) series of switches, part of its Project Sigma effort, support deployment of both wireline and wireless services, and thus, are targeted at CLEC, IXC, RBOC, and cellular service providers. Covered applications include calling card, messaging, single number dialing, intelligent call routing, and IP telephony.

< The VCO product can function as a core network transport switching platform, or as a switch component of a service node for feature development. Once developed in the service node, the feature can be shared across the network. The VCO is offered in both 2000 and 4000 port versions to match the service provider=s requirements. Summa Four supports its products with services such as design, development, testing, and deployment.

< Cisco Systems= acquisition of Summa Four adds significant new capabilities to the programmable switch. Since Cisco=s specialty is packet-based technologies, the integrated product line will support VoIP applications, delivering enhanced and value added services to packet-based networks.

Excel

Excel Switching Corporation provides open switching platforms for telecommunications service providers. The Expandable Switching System (EXS)ϑ is the technology framework for Excel=s product line. It utilizes its patented Programmable Protocol Language (PPL)ϑ technology for quick and easy customization of generic switch software. It is based on Excel=s Open Network Expansion (ONE)ϑ Architecture, which permits integration of switch functionality and advanced services as well as
support for multimedia interfaces.

< Excel=s EXSϑ efficiently integrates hardware and software. It is scalable and can support implementation options from 100 to 30,000 non-blocking ports. Products are targeted at entry-level, mid-range,

and large customers. Growth can be managed by the service provider in an incremental, cost effective manner as the number and kind of customers increase.

< EXSϑ is supported with two particular software products: Call Control and Resource. EXSϑ Call Control permits off-loading of basic network routing from the host switch. This allows programmability at the call control level.

< The ONEϑ architecture allows for the rapid development of services and solutions and is aimed at CLEC, IXC, wireless, and PCS providers. It is also targeted at developers of Advanced Intelligent Networks (AIN) and Enhanced Service Platforms (ESPs). ESP applications can be for local, tandem, and enhanced and Intelligent Network solutions. As services are developed via ONE, they are seamlessly integrated within the service provider=s network and switches.

< In its White Paper on Open Network Expansion for Telecom Networks Worldwide, Excel summarizes the opportunity that programmable switches offer to service providers: AWith ONEϑ Architecture, carriers are no longer limited by the complexity of traditional, hierarchical switching networks. They are no longer dependent upon switch suppliers for new services, new network connectivity, or new media support. They are not required to invest in new platforms each time they expand their networks. And they are no longer limited to offering the very same services that their competition can offer!=[22]

c) Additional Switching Configurations Available to CLECs

The above sections demonstrate the variety of state-of-the-art products targeted by vendors at new local service providers. But beyond these product lines, switch and transmission equipment manufacturers are offering new entrants a number of additional options and architectures to build and grow their switch networks gradually, thereby reducing their need for large up-front infusions of capital. These options include host/remote architectures, remote access to switch functionality, Digital Loop Carrier (DLC), and PBX switching configurations. They all permit cost effective, efficiently managed delivery of service to discreet, distant locations and geographic groupings of customers -- such as Multi-Dwelling Units (MDUs), buildings, commercial office parks, shopping malls, and campus arrangements.

[22] *Open Network Expansion for Telecom Networks Worldwide* (Section 5.0) Excel Switching Corporation, at 1, located at http://www.xl.com/onewhp.

Host/Remote, Remote Access. To reduce common equipment costs, many service providers use remote switches to extend the reach of hosts with high-capacity processors. New local service entrants will deploy one host and several remotes in each metro area they target. Remote capacity can range from less than 300 lines to up to 50,000 lines, depending on the CLEC=s current and future business needs. There are a number of size variations on the low end of these products, with options such as pre-designed configurations with cabinet enclosures for ease of deployment. Many remote products can be upgraded to the vendor=s full switch product, and any displaced equipment can usually be redeployed for a new remote opportunity. Distances between hosts and newly designed remotes are usually in the 600-mile range, with at least one planned product targeting a distance of 3000 miles.

Digital Loop Carrier (DLC) and Next Generation Digital Loop Carrier (NGDLC). Nortel=s AccessNode and DMS-1 Urban systems, Lucent=s SLC[7]-2000 Access System, SLC[7]-Series 5, DSC=s Litespan, AFC=s UMC-1000 3GDLC, and RelTec=s DISC*S[7] and Matrix® Broadband Multimedia Access Platform are a few examples of DLC products that -- like host/remote switch configurations -- allow service providers to limit investment to a small number of switches while still providing a full range of services to a widely dispersed customer base. Selective deployment of DLC products enables the new local service provider to cost-effectively reach customers with full functionality in areas not served by a switch. For instance, AT&T has stated that a single switch can readily serve customers within a 125-mile radius when used with digital loop carrier.[23]

Private Branch Exchange (PBX) Configurations. PBX equipment can be used by some service providers to deliver connections and features to small communities of interest. PBX trunks can be connected to IXCs for Long Distance, and ILEC, CLEC, and IXC Tandems for access to other in-region customers. Thus, PBX is yet another option to provide service while completely bypassing the ILEC local switch.

6. New Technology Options Allow A CLEC To Grow Its Network Efficiently

The architecture of today=s technologies offers all categories of service providers cost-effective, feature rich, scalable switching platforms that can evolve to meet company specific business and market plan objectives. Remote access options facilitate reaching geographically dispersed customers, even when the number of customers is small. Modular availability of features and functions supports the development of attractive, state-of-the-art service offerings. Bandwidth flexibility with loop/access systems permits deployment of full broadband capability, at the initial rollout or over time.

---

[23] *Petition of AT&T Corp. To Deny Application 24, GTE Corp., Transferor, and Bell Atlantic Corp. Transferee*, For Consent to Transfer of Control, CC Docket No. 98-184, November 23, 1998 at 24.

With the right platform, a long distance provider can easily become a local service provider. It is often advantageous, in terms of network efficiencies and reductions in operations costs, for the established long distance provider to update to one of the newer, multi-function switching platforms. In fact, many service providers are announcing their migration to such Aflattened≅ or Aconverged≅ networks. Likewise, with this same platform, a new local service provider can easily move into the long distance and data markets.

Internet and ATM networks can be easily integrated with the above local and long distance networks. Access networks that support both narrowband and broadband applications are integral parts of these networks. CATV companies and ISDN and xDSL technologies also provide efficient access to these Internet and ATM switching networks.

The reverse service migration path is also possible for Data CLECs with networks based on IP protocol. There are many products available today that overlay voice capabilities on such data platforms. There are also a significant number under development and in trial since this is one of today=s hottest technical capabilities. When the Data CLEC offers service this way, its customers can often utilize pipes they have already purchased to secure the new voice offerings. Overall, the Data CLEC has a converged platform that permits efficient, financially attractive integration of multiple functions.

In short, today=s telecommunications providers have a number of cost effective, appropriately-sized switching options that allow them to offer the services they desire in the necessary locations -- and in the required time frame. These options support all required functions with cost efficient interfaces across networks. New entrants are therefore able to build on their current investments, while continuously expanding the market segments they serve.

7. CLEC Provided Switching Functionality Is Available In All Geographic Markets

As discussed above, CLECs now provide their own switching functionality in all major MSAs and many smaller MSAs across the country. The ability to place remote switches and digital loop carriers further expands their ability to reach customers, and makes switching functionality available to CLECs in all geographic markets across the country. Attachments C and D illustrate this point.

Attachment C contains a map demonstrating that by deploying switches in only seven cities -- New York, Atlanta, Dallas, St. Paul, Denver, Los Angeles, and Spokane -- a CLEC can reach all the markets in the entire contiguous United States using Nortel=s remote switching modules, which can be located up to 650 miles from the host.

A more conservative analysis was performed based on AT&T=s premise that switching capability can be extended to a 125-mile radius using digital loop carrier (i.e., a remote switching module is not even necessary). Attachment D demonstrates that when the more conservative assumption of a 125-mile radius is used, virtually the entire eastern half of the continental United States can be reached by CLEC switches currently deployed

along with most of the major cities and many smaller areas in the western half.

B. CLEC Self-Provisioning of Switches Is Not Cost Prohibitive

Switch cost assumptions have been a major source of controversy in State and Federal universal service and interconnection proceedings. As a result, there are a number of cost estimates available for conventional telephony switches typically being installed by the ILECs. In the past, it was widely believed that switch deployment by a telecommunications provider required a capital investment in the millions of dollars. Today, however, this is not the case. As discussed above, telecommunications providers have the ability to purchase switching functionality on a small-scale basis. As their requirements for capacity grow, they can grow their switch capacity incrementally. Thus, CLECs and other new entrants into the telecommunications market are able to purchase and in fact are purchasing their own switching functionality.

A review of the switching costs contained in the Synthesis Model adopted by the FCC for purposes of calculating Universal Service Costs provides an indication of what the FCC believes is a reasonable estimate of switching costs.[24] The FCC Model currently bases its USF calculations on a getting started cost of $447,000 for stand-alone and host switches, a getting started cost of $186,400 for remote switches with a per-line cost of $83 assigned to all three types.[25]

[24] In the Matter of the Federal-State Joint Board on Universal Service, In the Matter of the Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket No. 96-45, 97-160, *Fifth Report and Order*, FCC 98-279 (rel. Oct. 28, 1998).

[25] *FCC Synthesis Cost Proxy Model* (as released at www.fcc.gov/ccb/apd/hcpm on May 18, 1999).

Similarly, the HAI model, sponsored by AT&T & MCI in numerous USF and UNE proceedings, demonstrates that these companies believe that the cost of self-providing switches is low.[26] The Model uses an algorithm that represents what it refers to as a "blended overall efficient mixture of host, remote, and standalone switches within the modeled network" to calculate switch costs when run in the default mode.[27] However, when run with the host/remote option enabled, the HAI model uses the following estimates for costs that "an efficient firm would incur to provide unbundled network elements ("UNEs"), universal service, and interconnection services."[28] The table below displays the switching costs calculated by the HAI Model for small Independent Telephone Companies (ICOs).[29]

TABLE 5: HAI 5.0a - Switch Costs for Small ICOs

line size	standalone fixed investment	standalone per line investment	host fixed investment	host per line investment	remote fixed investment	remote per line investment
0	$300,001	$129	$315,001	$129	$17,143	$146
640	$300,001	$129	$315,001	$129	$94,286	$141
5000	$300,001	$129	$315,001	$129	$120,000	$146
10000	$814,289	$124	$855,003	$124	$385,716	$120

Furthermore, there is early evidence that the currently emerging packet telephony switch market will reduce start-up costs even more significantly. For example, Lucent Technologies recently unveiled its PathStar Business Service Exchange, which provides voice and data services over IP or ATM packet networks. The PathStar is scheduled to begin shipping in July 1999, with prices starting at about $100,000 for an entry-level

[26] This in not to say that switches are *perfectly* scalable. They do have an up front cost component to cover. For example, the central processor unit of a host or remote switch must be present regardless of the number of lines served by the switch.

[27] *HAI Model Release 5.0a Model Description* ¾6.5.3.1, at 56 (Feb. 2, 1998).

[28] Direct Testimony of Brenda J. Kahn on Behalf of AT&T Communications of the Southwest, Inc., Before the Public Service Commission of Missouri, Docket No. TO-98-329 (June 30, 1998) at 7.

[29] The costs referenced in this discussion are espoused by FCC HAI Model sponsors. Neither GTE nor NECI necessarily agree that these costs accurately represent GTE=s or any other ILEC=s costs, however.

configuration.[30] Other industry information suggests that IP router prices will drop about 50 percent every 10 to 20 months. So a $100 IP port might cost only $50 in 18 months.≅[31]

C. CLECs That Provide Their Own Switching Functionality Are Experiencing Brisk Revenue Growth

One measure of CLEC success is the rapid growth in revenues that CLECs are experiencing. Table 6 below provides a synopsis of the revenue growth of selected CLECs -- all of which have chosen to expand some or all of their switching networks without relying on ILEC facilities. It is evident from these high revenue growth rates that CLECs are expanding their markets and successfully acquiring new customers.

TABLE 6: TOTAL REVENUE GROWTH OF SELECTED CLECS THAT PROVIDE THEIR OWN SWITCHING FUNCTIONALITY ($M)

CLEC	**1995**	**1996**	**1997**	**1998**	**% Chg. 95-98**	**1Q 1999**
21st Century Telecom Group	n/a	n/a	n/a	.94	n/a	1.125
Allegiance Telecom	n/a	n/a	n/a	9.8	n/a	10
Birch Telecom	n/a	n/a	n/a	22	n/a	10.6
Business Telecom, Inc.	114.5	148.8	195.0	212.5	85.6%	56.9
Cablevision Systems (Lightpath)	1,078	1,315	1,949	3,265	203%	934
CommNet Cellular	89.8	115.2	150.9	171.4	90.9%	n/a
Cox Communications	1,286	1,460	1,610	1,717	33.5%	498.5

[30] Jeff Patryka and Paul Krill, *Packet telephony gets PSTN capabilities*, InfoWorld, May 3, 1999, at 28.

[31] Ike Elliot, Senior Director of Network Engineering of Level 3 Communications Inc.as quoted in *CLECS Toeing VOIP Waters*, by Gary Kim (May 1999) located at www.soundingboardmag.com/articles/951feat2.html.

TABLE 6: TOTAL REVENUE GROWTH OF SELECTED CLECS THAT PROVIDE THEIR OWN SWITCHING FUNCTIONALITY ($M)						
Electric Lightwave, Inc.	15.7	31.3	61.1	100.9	543%	38.2
e-Spire	1.2	9.4	59	156.8	12967%	58.1
FirstWorld	n/a	n/a	n/a	1.1	n/a	8.26
Focal Communications	n/a	n/a	4.0	43.5	988%	26
Frontier Communications	2,144	2,576	2,353	2,594	21%	675
GCI of Alaska (General Communications)	129.3	164.9	224	246	90.3%	61.3
GST Telecommunications	n/a	41.3	106	163.3	295%	55.7
Hyperion Communications	1.7	3.3	5.1	13.5	694%	26.5
ICG Communications	122.4	190.6	273.4	397.6	225%	129.5
Intermedia Communications, Inc.	38.6	103.4	247.9	712.8	1747%	204.7
ITC DeltaCom	5.8	66.5	114.6	171.8	2862%	53
McLeodUSA	29	81.3	267.9	604.1	1983%	181.1
MCI WorldCom	3,640	4,485	7,351	17,678	386%	9,001
MediaOne	2,374	2,955	5,043	2,882	21.4%	665
MGC Communications	n/a	n/a	3.8	18.2	379%	8.4
Pac-West Telecom	n/a	n/a	29.6	42.2	42.6%	14.4
RCN	92.0	104.9	127.3	210.9	129%	67.4
Time-Warner Telecom	6.9	23.9	55.4	121.9	1667%	47.6
US LEC	n/a	0.0	6.5	84.7	1203%	36.2
WinStar	29.8	68	79.6	244.4	720%	88.1

III. Analysis Of Transport Alternatives Available To CLECs

Today, there are alternatives available to CLECs that require interoffice transport capabilities. Advances in technology have afforded CLECs the opportunity to

economically construct their own facilities, and many have done so. In addition, numerous suppliers of interoffice facilities -- such as Interexchange Carriers, Competitive Access Providers, and CLECs -- are leasing their surplus facilities to CLECs and other telecommunications providers. Manufacturers are also providing products to the many Aniche≅ markets that are emerging.

A. CLECs Are Providing Their Own Interoffice Facilities

Research indicates that many CLECs are providing their own interoffice facilities rather than leasing them from alternate providers. While spectrum owners like WinStar, Teligent, TGC (now part of AT&T), and NEXTLINK are using 38-Ghz digital radio systems, CLEC interoffice transport is furnished almost exclusively over fiber-optic cable facilities.[32] For instance, Dakota Services, LTD. has a national data network consisting of ATM, frame relay, DS1 to DS3, and fiber-optic direct links. Its technology platform provides a secured dedicated LAN connection that can span across a LATA or across the country.[33] Similarly, Cablevision Lightpath provides a full-range of local, switched services, private line, and advanced networking features on the local and long distance levels over its own facilities and networks.[34] And BTI Telecommunications Services is constructing a 3,250-mile long-haul fiber network.[35] It now has fiber in service between New York City and Washington, D.C., and from Rocky Mountain to Charlotte, North Carolina. It carries a substantial percentage of its North Carolina traffic on its own fiber network. The company=s entire fiber network is to be completed from New York to Miami, and from Atlanta to Nashville, by the end of the second quarter of 1999. BTI also intends to provide wholesale services to other telecommunications carriers.[36]

The majority of CLECs that are self-provisioning transport over fiber-optic facilities are doing so using Synchronous Optical Network (SONET) technology. The SONET architecture is favored because of its inherent flexibility, survivability, scalability, and lower relative cost compared to asynchronous transport technologies. In a SONET system, each

---

[32]Industry Analysis Division of the Common Carrier Bureau, *Trends in Telephone Service* (Feb. 1999) (Table 18.3), FCC Website, www.fcc.gov/ccb/stats.

[33]http://www.dslnet.com/About_Dakota/Press_Releases/February_1_1998/body_February_1_1998.html.

[34]Cablevision Website, http://www.cablevision.com/cvhome/cvphone/phone.htm.

[35]Since the CLECs are unencumbered by LATA boundaries, these Along-haul≅ networks are used for both inter-LATA and intra-LATA transport.

[36]BTI Website, http://www.btitele.com/new/release.cgi?timestamp=920264401.

individual customer signal, or "synchronous payload envelope"[37] is directly accessed by less expensive "add-drop" multiplexers located at nodes along the SONET ring. Spurs can be extended from the ring to additional "off-ring" nodes that are located outside the ring. And traffic can be shared between different rings at common nodes.

As to survivability, the SONET architecture is designed to provide uninterrupted service in the event of a fiber or electronics failure. Each multiplexer on a SONET self-healing ring transports its traffic in two directions along the ring. For instance, the active channel may transit the fiber-ring in a clockwise direction while the standby channel leaves the node in a counterclockwise direction. In the event of a fiber failure anywhere along the ring, the system instantaneously switches all affected traffic to the alternate signal path.

The scalability of the SONET-fiber technology is a result of two factors. *First*, capacity can be added incrementally to SONET systems by adding (rather than replacing) electronics. The typical, entry-level SONET system operates at the OC-3 rate of 155 Mbits per second or 84 DS1s. The 1.544 Mbit DS1 rate is generally the lowest transport speed required, because all digital switches available today interface the network at this rate. These systems can be upgraded to OC-12 (622 Mbit, 336 DS1s), OC-48 (2.4 Gbits, 1344 DS1s), and OC-192 (10 Gbits, 5376 DS1s). Most products available today allow such upgrades to be done "in-service."

Second, the number of individual wavelengths (or colors) that each fiber carries can be increased through the use of wave division multiplexing. Transmission rates of 40 Gbits per second on a single fiber are achievable today using products like CIENA's Multiwave 1600 Terminal, which allows up to 16 OC-48 channels to be carried over a single fiber. And the future brings the promise of even greater capacity. Lucent has successfully tested a 1 terabit (1 trillion bits) fiber-optic transmission system. The advantage of using these state-of-the-art technologies is clear: Once the initial investment in the fiber infrastructure is made, capacity for new and growing customer demand can be added at a relatively low incremental cost.

[37] "The payload is the revenue-producing traffic being transported and routed over the SONET network." http://www.webproforum.com/tektronix/topic03.html.

The table below contains a sample of CLECs that provide their own transport functionality. It is interesting to note that even though this is only a small sample, these CLECs are operating in most major and in many smaller markets. It is important to note that several of these CLECs are also providing their own loop facilities on SONET Fiber Rings.[38] This is another major advantage of this technology. It is service-independent or transparent. That is, the same SONET rings can be used to carry both loop and interoffice traffic by placing nodes at any switch site or customer location along the ring path.

TABLE 7: SELECTED CLECs PROVIDING THEIR OWN TRANSPORT FACILITIES

CLEC	TYPE OF CLEC	MSA RANKING(S)
Allegiance Telecom	Traditional	1-7,9,10,11
AT&T	Traditional/Wireless	1,2,3,4,5
Bay Ring Communications	Traditional	7
Birch Telecom	Traditional	18,24
BTI	Traditional	1,4,11,12,32,38,200
Cablevision Systems (Lightpath)	Cable/Telephony	1
Caprock Communications	ICP	9,28,33,42,45,62,72, 148,156,160, 216
Electric Lightwave, Inc.	Traditional	2,13,22,25,34,35,95, 103
e-Spire	Traditional	1,4,9,101
FirstWorld	Traditional	2
Focal Communications	Traditional	1,2,4,5,6,7,

[38] *See* Section IV *infra.*

TABLE 7: SELECTED CLECs PROVIDING THEIR OWN TRANSPORT FACILITIES		
Frontier Communications	Traditional	1-9,11,13,16,17,18,20, 21,24,26,40,60,103
FTV Communications	Traditional	2,17
GST Telecommunications	Traditional	2
Hyperion Communications	Traditional	1,4,6,12,19,21,33,36, 41,43
ICG Communications	Traditional	2,5,17,42,101
Intermedia Communications, Inc.	Traditional	42
ITC DeltaCom	Traditional	9,21,30,76,145,155, 151
KMC Telecom Corp.	Traditional	8,16,37,71,74,81,82, 85,98,99,101,102104, 116,130,135,155,183
Level 3	Traditional/Wholesale	1-11,13,17,20
McLeodUSA	Traditional/Wireless	18,29,92,159,171,234, 252
MCI WorldCom	Traditional	1-30,40,41,42,43,46, 50,54,56,57,58,62,63, 64,68
MediaOne	CATV/Telephone	2,12,16,203
PaeTec	Traditional	1,2,4,5,6,7,12,21,40, 44,54,100
Qwest	Traditional/Wholesale	1,2,25
RCN	CATV/Telephone	4,5,7,17
Teligent	Wireless	2,4,5,6,7,9,10,11,12, 20,21,26,33,40,41,42, 43,45,57,59,60
Time-Warner Telecom	CATV/Telephone	1,17,21,23,29,40,41,42, 43,54,55,
Touch America	Traditional/Wholesale	9,20,35
WinStar	Wireless	1-18,21,22,24,26,33

TABLE 7: SELECTED CLECs PROVIDING THEIR OWN TRANSPORT FACILITIES
See Appendix A for table sources.

B. Interoffice Facilities Are Widely Available From Wholesale Providers

In addition to constructing its own transport facilities, CLECs in many markets also have the option of leasing transport capacity from wholesale providers that are leveraging the essentially limitless capacity of their embedded fiber networks to generate additional revenues. Companies such as Touch America, Williams, and Qwest Communications, to name a few, have spare capacity on their interoffice networks and lease this capacity to CLECs and other telecommunications providers. As described below, many of these companies offer their services on a nationwide basis, thereby making interoffice transport alternatives widely available.

< **Touch America**

Touch America has significant transport facilities in all major MSAs in the Northwest, including MSAs in Washington, Oregon, Idaho, and Wyoming, as well as in Wisconsin. They also have covered the largest cities on the West Coast. Future expansion plans include New Mexico, Texas, and Arizona. They also plan to link New York City with Chicago and Kansas City.[39] In addition, Touch America is constructing a $50 million Salt Lake City-Denver-Dallas expansion to add to its existing 10,000 mile fiber optic network. It has pre-sold capacity on the 1,029 mile Denver-Dallas leg of the expansion.[40] Touch America=s total 1999 fiber network installed or under construction is expected to be 12,000 miles.

< **Williams Telephone**

[39] clec.com, http://www.clec.com.

[40] *Touch America to Expand Fiber Network from Salt Lake to Denver to Dallas* (located at http://mpc.in-tch.com:30080/headlines/1999_Releases/02-22-99.htm) (Feb. 1999)

Williams Communications has recently partnered with Pacific Fiber Link to construct a 715 mile fiber-optic loop, linking Sacramento to Portland. In return for their $47.2M investment, Williams will have access to all network facilities along the route. Moreover, in a December 1998 press release, Williams announced that they have inked a deal with WinStar to provide WinStar access to Williams= planned national network. The deal was valued at $640M. Similar deals have been struck with Touch America.[41] ATM transport and backbone connectivity are two of the most important issues for Williams Telephone=s wholesale customers. ATM transport is used to integrate multiple services and transmit video across the company=s network. Backbone connectivity makes it possible for NSPs, ISPs, RBOCs, and CLECs to build and extend the geographic presence of their networks.[42]

< **Qwest Communications**

Qwest Communications of Denver has expanded its fiber network to include over 32 major MSAs across the United States. They have a footprint covering the entire East Coast, including Boston, New York, Philadelphia, Charlotte, Atlanta, Tampa, Jacksonville, and Miami. The heartland is also targeted in Detroit, Cleveland, Columbus, Cincinnati, and others. The West Coast footprint includes, but is not limited to, Seattle, Portland, Sacramento, Los Angeles, San Diego, and Tucson. And plans are underway into expand to second and third tier MSAs across the United States. In addition, many agreements have been signed for cooperative use of spare bandwidth with such companies such as Covad, e-spire, Hyperion, and STAR.[43]

< **Metromedia**

Metromedia Fiber Network operates a 380,000-mile fiber-optic communications network in the New York City Metropolitan area and in Chicago, Philadelphia, and Washington, D.C. It provides access to its network through lease arrangements with communications carriers, including local exchange, long-distance, paging, cellular, PCS providers, cable companies, ISPs and corporate and government customers.[44]

< **Electric Lightwave**

---

[41] clec.com, http://www.clec.com.

[42] http://www.willtales.com/network/non_flash/products/atm/index.html.

[43] clec.com, http://www.clec.com.

[44] *Id.*

Electric Lightwave owns and operates Metropolitan Area Networks (MANs) in Seattle, Spokane, Portland, Sacramento, Phoenix, Salt Lake City, and Boise. It builds and operates all-digital, high-speed fiber-optic networks for businesses and long-distance carriers across the United States.[45]

[45] Electric Lightwave Website, http://www.eli.net/about.html.

The chart below demonstrates the rapid growth in the type of serving arrangements discussed above.[46] As depicted in the chart, with an expected growth rate of 60% between 1996 and 2000, this has become one of the fastest growing segments of the telecom industry. This chart offers strong proof that telecommunications providers are taking advantage of the alternatives available in the marketplace for their interoffice facilities requirements.

In addition to wholesale providers, there are a number of niche companies that have emerged to provide telecommunications services to the CLECs. These carriers typically offer services either locally or regionally, and differentiate themselves with unique, lower-priced services.

[46] Tele.com magazine, January 25, 1999, at 38.

One of the newer niche services to surface in the industry is the ACollocation Hotel.≅ Companies like Colomotion, Inc., the Colocation Corporation, and Switch and Data Facilities provide neutral Ahotels≅ where carriers can interconnect with each other (rather than having to interconnect at the ILEC premise). These facilities are ideal locations for SONET Ring intersections between CLECs and their wholesale transport, loop, and interconnect partners. In addition, some CLECs and ISPs are also allowing other CLECs to collocate in their offices. AColomotion is the first carrier-neutral, collocation facility offering a solution for ISPs and other Internet-based companies to share emerging technology, bandwidth allocation, transit costs, peering and multiple access methods under one roof. Colomotion customers and partners are provided with a secure scalable, non-congested Internet exchange point.≅[47] These unique sites provide CLECs, ILECs, long-distance carriers, and other carriers a neutral location to interconnect, thereby eliminating the need to use ILEC central offices.

C. CLEC Transport Alternatives Are Not Cost Prohibitive

Like switch cost assumptions, transport costs have been discussed in some detail in State and Federal universal service and interconnection proceedings. Each of the models proffered by the various parties to these proceedings contain estimates of the costs associated with the installation of interoffice network components.

The chart below, which contains cost estimates from both the FCC universal service model and the HAI model sponsored by AT&T & MCI,[48] demonstrates the Commission and IXCs belief that a relatively small up-front investment in fiber infrastructure will provide seemingly unlimited capacity for future growth. (See Attachment E for an illustration of the assumed network topology.)

HAI COST FOR A ONE-HUNDRED MILE, FOUR-NODE, OC-3 FIBER RING			
Item Description	**Unit Cost**	**Quantity**	**Extended Cost**
24-fiber cable[49]	$3.50	528,000	$1,848,000
Structure (blended,	$1.87	528,000	$987,360

[47]Colomotion Website, http://www.colomotion.com.

[48]These costs are espoused by the Model sponsors. Neither GTE nor NECI necessarily agree that these costs accurately represent GTE=s or any other ILEC=s costs, however.

[49]The default number of fibers assumed by the HAI Model for an interoffice fiber cable is 24. *HAI Model Release 5.0a, Inputs Portfolio* (Jan 27, 1998) ¬4.4.2.

HAI COST FOR A ONE-HUNDRED MILE, FOUR-NODE, OC-3 FIBER RING			
per foot)			
Optical Patch Panel	$1,000	4	$4,000
Fiber Pigtail	$60	16	$960
OC-3/DS1 ADM	$26,000	4	$104,000
OC-12 ADM	$40,000	0	$0
OC-48 ADM	$50,000	0	$0
EFI @ 32 Hrs/Site	$1,760	4	$7,040
Total			**$2,951,360**

This system provides capacity for 84 DS1s (2,048 voice grade equivalent circuits) traversing the ring over four fibers. Additional capacity can be added by placing additional OC-3 systems on the 20 spare fibers, by upgrading the electronics to OC-12, OC-48, or even OC-192 capacity, or by placing wave division multiplex devices at each site to enable several systems to share the same fiber. This could be scaled to over 12 million circuits using technology available today, although it is highly unlikely that traffic between four offices would ever reach these levels.

This example also provides insight into the motivation of wholesale transport providers. Once the initial infrastructure investment has been made, the incremental investments for capacity upgrades are relatively small. For example, to quadruple the capacity of the transport network illustrated in the table above, the four OC-3 ADMs could be converted to OC-3/DS1 Terminal and augmented with 12 additional terminals at $26,000 each and 4 OC-12 ADMs at $40,000 a piece, for a total incremental investment of just $480,000 (or a 16% increase in total investment). It is important to note that the original OC3 investment is fungible; that is, the equipment is reused in the upgrade process rather than replaced.

D. CLECs That Choose Transport Alternatives Are Experiencing Rapid Revenue Growth

The table below highlights the revenue growth of selected CLECs that choose to use transport alternatives. It is evident from the revenue growth presented in the table that these CLECs are expanding their operations at a very rapid pace.

TABLE 8: TOTAL REVENUE GROWTH OF SELECTED CLECS THAT PROVIDE THEIR OWN TRANSPORT FACILITIES ($M)

CLEC	1995	1996	1997	1998	% Change 95 - 98	1Q 1999
Allegiance Telecom	n/a	n/a	n/a	9.8	n/a	10
Birch Telecom	n/a	n/a	n/a	22	n/a	10.6
Business Telecom, Inc.	114.5	148.8	195.0	212.5	85.6%	56.9
Cablevision Systems (Lightpath)	1,078	1,315	1,949	3,265	203%	934
Caprock Communications	n/a	n/a	n/a	121.8	n/a	37
Electric Lightwave, Inc.	15.7	31.3	61.1	100.9	543%	38.2
e-Spire	1.2	9.4	59	156.7	12967%	58.1
FirstWorld	n/a	n/a	n/a	1.1	n/a	8.26
Focal Communications	n/a	n/a	4.0	43.5	988%	26
Frontier Communications	2,144	2,576	2,353	2,594	21%	675
GST Telecommunications	n/a	41.3	106	163.3	295%	55.7
Hyperion Communications	1.7	3.3	5.1	13.5	694%	26.5
ICG Communications	122.4	190.6	273.4	397.6	225%	129.5
Intermedia Communications, Inc.	38.6	103.4	247.9	712.8	1747%	204.7
ITC DeltaCom	5.8	66.5	114.6	171.8	2862%	53

TABLE 8: TOTAL REVENUE GROWTH OF SELECTED CLECS THAT PROVIDE THEIR OWN TRANSPORT FACILITIES ($M)						
McLeodUSA,	29	81.3	267.9	604.1	1983%	181.1
MCI WorldCom	3,640	4,485	7,351	17,678	386%	9,001
MediaOne	2,374	2,955	5,043	2,882	21.4%	665
RCN	92.0	104.9	127.3	210.9	129.2%	67.4
Teligent	n/a	1.4	3.3	1.0	(28.6%)	1.5
Time-Warner Telecom	6.9	23.9	55.4	121.9	1667%	47.6
WinStar	29.8	68	79.6	244.4	720%	88.1

IV. Analysis of Loop Alternatives Available to CLECs

CLECs currently have a significant number of conventional and emerging technology options at their disposal in lieu of purchasing or reselling local loops obtained from incumbent LECs. And the number of loop alternatives available to CLECs is increasing at a rapid pace. This is due in part to the new technologies that are available with a broad range of feature options from an ever-increasing number of manufacturers. These new technologies -- which include Access Systems, digital and fiber-optic Multiplexer arrangements, Transmission systems, Pair-Gain Systems, xDSL, and Digital Loop Carrier Systems -- can be obtained in various quantities and at a broad range of prices. In addition, recent merger and partnership activity in the telecommunications industry sends a clear signal that CLECs intend to provide their own local loops in many markets across the United States. Finally, the emergence of new radio technologies is enabling CLECs to use wireless local loops to reach their customers. The information presented below demonstrates that there are local loop alternatives available across the United States -- alternatives that CLECs are taking advantage of in many markets.

A. CLECs Are Providing Their Own Local Loops

Rather than purchasing loops from an ILEC or a wholesale provider, some CLECs are opting to construct their own loop networks. This is true in both urban and suburban areas, where CLECs and CAPs have proven that it is feasible to build their own fiber networks, and in rural areas, where companies are deploying Afixed wireless≅ networks.

As with transport facilities, the majority of CLECs that are self-provisioning loops are doing so using Synchronous Optical Network (SONET) Fiber Rings. Since the SONET topology provides ready drop and insert access to individual DS1 payloads, this architecture is ideal for serving business customers with requirements of 20 or more lines. The 24-channel DS1 (or T1) loops are generally priced less than 20 or more individual

business lines.

The inherent flexibility, survivability, scalability, and lower relative cost of SONET fiber networks, as described in the transport section of this paper, also applies to the loop network. Likewise, the economic advantages of using these state-of-the-art technologies are equally applicable. Once the initial investment in the fiber infrastructure is made, capacity for new and growing customer demand can be added at a relatively low incremental cost. With regard to scalability, RCN's network build-out strategy is a good illustration of today's fiber technology: "We're building networks on the >80/20' model. That is, we're utilizing less than 20% of our network capacity. That means we have enough fiber to support over 80% more capacity than what our four services require today. Why? As more Internet-based and inspired applications are invented -- and they will be -- we can sell more products and services without having to upgrade our infrastructure. That leads us into a virtuous circle, where we can increase our revenue with little or no capital investment."[50]

In addition to traditional fiber-optic cable technology, companies are beginning to deploy Afixed wireless≅ technology to reach their customers in urban, suburban, and rural areas. WinStar and Teligent are using 38 Ghz digital microwave radio systems to offer point-to-point DS1 and DS3 links to provide local, long distance, Internet and data services to their business customers. Since there is no need to dig up streets or obtain rights-of-way to place cable, these digital radio systems can be installed and turned up in days, rather than weeks or months. It is projected that fixed wireless service spending will skyrocket from $6 million in 1999 to $679 Million in 2002.[51] Even AT&T plans to use fixed wireless technology to serve customers where its cable-TV lines do not reach.[52]

Like the SONET fiber rings, these digital microwave radio systems are ideally suited to customers requiring 20 lines or more, because a single DS1 channel carrying up to 24 equivalent voice-grade channels can be economically provided and rapidly augmented as additional capacity is required. In addition, since the transport is all digital, Internet, LAN, WAN, and video traffic can be easily accommodated.

---

[50]RCN 1998 Annual Report, Letter to Shareholders from David C. McCourt.

[51]1999 MultiMedia Telecommunications Market Review and Forecast, TR Daily, March 8, 1999.

[52]*AT&T to Enter Some Local Markets Using Its AFixed Wireless≅ Technology*, Wall Street Journal, Mar 19, 1999, at B6.

In the residential market, CATV companies have augmented their existing coaxial cable networks with fiber and are actively marketing telephone services over their upgraded facilities, thus demonstrating the feasibility of Acable telephony.≅ AT&T has announced its intention to offer residential telephony over facilities acquired in its mergers with TCI and MediaOne and in its partnership with Time Warner. AT&T=s newly and soon to be acquired facilities pass by 26.5 million homes and Time Warner=s facilities pass another 20 million, giving AT&T access to approximately 60% of the households in the U.S.[53] Accordingly, AT&T=s Chairman, C. Michael Armstrong has touted its latest acquisition of MediaOne as meaning that A[f]ar more American consumers will have a choice of local telephone service.≅[54] However, none of the CATV companies are currently offering wholesale loop UNEs. In fact, AT&T has been openly hostile to suggestions that it be compelled to offer unbundled loop UNEs to competitors.[55]

But the CLECs that are providing service over their own loop facilities are not just limited to the examples above. The following quotation from a recent *Outside Plant* magazine editorial provides a few more examples, and explains the motivation of these companies: AToday, you can=t help but notice the trend of CLECs installing their own infrastructure. I=ve watched 21st Century here in Chicago install their network along the right-of-way of our mass transit rail system. Elsewhere, IXC, Allegiance, Qwest, Frontier and others are installing networks at a large expense. They all hope to grab a portion of the billion dollar voice and data market.≅[56]

---

[53]AT&T Website, http://www.att.com/press/item/0,1193,439,00.html.

[54]*Id.*

[55] In a recent press release, AT&T Chairman C. Michael Armstrong protested that, A[n]ocompany will invest billions of dollars to become a facilities-based broadband services provider if competitors who have not invested a penny of capital, nor taken an ounce of risk, can come along and get a free ride on the investments and risks of others.≅ *Armstrong Fires Back at Critics of TCI Deal*, TR Daily, March 1999.

[56]Sharon Stober, *Digging Deeper*, Outside Plant, Dec. 1998, at 6.

In fact, the ubiquity of an ILEC=s embedded loop plant does not guarantee that CLECs will be able to provide the services their customers= desire. Quite often, particularly in suburban and rural areas, the ILEC=s loop will have loaded copper pairs that require expensive and time consuming conditioning before they can be used to provide the services the CLECs are marketing. In urban and dense suburban areas, the ILEC cable facilities may contain "recognized disturbers, such as AMI T1" which the Commission believes "should, to the fullest extent possible," be replaced with new and less interfering technologies.[57] For some CLEC services -- *e.g.*, DS3 transport and FDDI -- the ILECs embedded loop facilities cannot be used at all. This is one reason why, as discussed above, CLECs are opting for facilities-based network elements. By providing their own loops in conjunction with the new technologies discussed below, CLECs can more efficiently target their high-margin customers with a multitude of advanced digital services as well as traditional voice telephone. These new technologies include:

- Lower-cost NGDLC digital loop carrier systems[58]
- Integrated Access Terminals
- Digital Subscriber line (DSL or xDSL)
- SONET Fiber Rings
- Hybrid Fiber Coax Systems
- Wireless Access: Fixed Wireless Local Loop; Digital Microwave Radio; Cellular/PCS

While some of these technologies are designed to extend the capabilities of the existing copper infrastructure -- *e.g.*, xDSL and small DLC systems -- many companies, offer low cost, feature-rich alternatives to traditional technologies using fiber or radio spectrum. For example, Alcatel USA (formerly DSC Communications) has augmented its Litespan 2000 NGDLC System with the fiber-based Starspan ONU-24 and the copper-based Litespan 200 System, which it advertises as a cost-effective, rapid deployment solution for small line-size applications. Both of these products can be used to extend service to customers outside

---

[57] In the Matters of Deployment of Wireline Services Offering Advanced Telecommunications Capability, CC Docket No. 98-147, First Report and Order and Further Notice of Proposed Rulemaking, FCC 99-48, at 74 (rel. March 31, 1999).

[58] In a March 29, 1999, FCC Ex Parte, AT&T submitted cost documentation for small fiber DLC systems (up to 240 lines) stating, A[I]n contrast to the input values for 24-line DLC now existing in the SM=s test data set, modern small DLCs are priced much more economically.≅

of the fiber rings on which Litespan 2000 is deployed. In addition, Lucent Technologies has augmented its SLC 2000 NGDLC System with its AnyMedia Access third generation digital loop carrier system, which works over fiber, copper, or wireless media. Lucent claims that this platform can reduce service delivery costs by more than 20%. And Advanced Fiber Communications, Inc. has combined its newly developed digital spread spectrum radio system with its UMC-1000 3GDLC system to provide wireless connectivity.

Significantly, the ability of the CLECs to offer their customers a full range of services over modern digital facilities often provides them a competitive edge over the ILECs. According to David McCourt, Chairman and CEO of RCN Corporation: "RCN sees those opportunities. We're making bold moves. We're building a new network with lower operating costs. The telco incumbents are still operating networks that depend on twisted copper wires and technology invented more than 100 years ago. To be sure, the incumbents are spending billions to upgrade their networks. But retrofitting 19th century technology to meet the needs of the 21st is like trying to keep an old car roadworthy for superhighway speeds. The result is a vicious circle, where you have to keep putting more money into the network before you can increase revenues. We don't do that. Our network already has plenty of excess capacity."[59]

The table below contains a representative listing of facilities-based CLECs, by area and facility type. It demonstrates that CLECs are reaching customers over their own facilities in most major markets in the United States. This type of facilities-based arrangement will become more prevalent as the market further develops and industry consolidations continue to occur. The availability of new technologies and the continued upgrade of CATV facilities, which currently pass more than 90% of the homes in the U.S., will also further the proliferation of facilities-based loop providers.

TABLE 9: SELECTED CLECs PROVIDING THEIR OWN LOOP FACILITIES

CLEC	**TYPE OF CLEC**	**TECHNOLOGY**	**MSA RANKING OF LOCATIONS ( ) = # cities in MSA**
21st Century Telecom Group	Cable/ISP/Local/LD	Fiber Optic Ring	3
American MetroComm	Local/LD/ISP/ISDN	Fiber Optic Ring	33
AT&T	Local/LD	SONET Fiber Rings (10,000 miles)	300 Communities including: 1, 2, 3, 4(2), 5, 7, 8, 9,

[59]Letter to Shareholders from David McCourt, RCN 1998 Annual Report.

TABLE 9: SELECTED CLECs PROVIDING THEIR OWN LOOP FACILITIES			
CLEC	**TYPE OF CLEC**	**TECHNOLOGY**	**MSA RANKING OF LOCATIONS ( ) = # cities in MSA**
			10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 29, 30, 32, 35, 36, 39, 51, 53, 61, 63, 88, 133
Cox Communications	Local/Cable	HFC	1, 4, 15, 17, 61
Electric Lightwave, Inc.	Local/Data/ISP/ATM/ Wireless/Video	SONET Fiber Rings	Eighty-four (84) municipalities in western United States. These full service markets include: 13, 15, 22, 25, 35, 103
e.spire	Local/LD/Cable Data/Internet	SONET Fiber Ring	4, 9(2), 21, 24, 28, 31, 33, 34, 42, 44, 48, 52(2), 53, 57, 58, 60, 62, 71, 72, 76, 79(2), 80, 88, 91, 93, 101, 119, 156
GST Telecommunications	Local/LD/ISP ATM/OS	Fiber	2, 5, 10, 13, 15, 22, 57, 62, 95
Logix	Wireless/ISP/CPE/data	Fiber Optic Ring	45
MediaOne	Local/Cable/ISP	HFC	2, 7, 11, 12, 44, 50
Nextlink		Fiber	1(2), 2, 3, 4, 5, 6, 9, 11, 12, 13, 15, 20, 22, 23, 35, 38, 41, 66, 86, 111, 130, 226
McLeodUSA	Local/LD	SONET Fiber Ring	3, 26(2)
RCN	Local/LD/Cable/ISP	SONET Fiber Backbone	1, 4, 6, 7, 17
Time Warner Telecom	ISP	SONET Fiber Rings	1, 10, 17, 21, 23, 26, 28, 29, 30, 32, 37, 40, 41, 42, 43, 55, 133, 139, 237
Teligent	Local/Data/ISP Wireless	Digital Microwave	1(3), 2(2), 3, 4(3), 5, 6, 7, 8, 9, 10, 11, 12, 13, 14(2), 15, 16, 17, 18,

TABLE 9: SELECTED CLECs PROVIDING THEIR OWN LOOP FACILITIES			
CLEC	**TYPE OF CLEC**	**TECHNOLOGY**	**MSA RANKING OF LOCATIONS ( ) = # cities in MSA**
			19, 20, 21, 22, 23, 24, 25, 26, 27(2), 28, 29, 30, 31, 32, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 47, 48, 49, 50, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 67, 70, 71, 73, 78, 83, 100
Touch America	Local/LD/ISP	LMDS and Fiber	223 (2) (planned 30 city build out)
WinStar Communications	Local/Data/LD/ISP Wireless	Digital Microwave	1(2), 2, 3, 4(2), 5(2), 6, 7, 8, 9(2), 10, 11, 15, 17, 26 (Planned - 1, 2, 3, 12, 13, 14, 16, 18, 20, 21, 24, 31)
See Appendix A for table sources.			

B. CLECs Are Purchasing Local Loops From Wholesale Providers

In today=s telecommunications environment, there are a number of providers that offer alternative loop elements to ILECs, CLECs, IXCs, and ISPs on a wholesale basis in metropolitan areas. In this type of arrangement, the CLEC and the wholesale provider choose a mutually agreed upon point of interconnection and form of handoff. The point of interconnection could be the CLECs= site, the wholesale provider=s site, or some other mutually agreed upon location (such as Acollocation hotels≅ discussed in Section III). The parties also agree upon the form of handoff: fiber or T-1, DSO level or something higher. And the modern digital facilities provided by the wholesalers permit CLECs to offer essentially any service, from voice telephony to broadband data and video.

The table below is a partial list of companies that are currently providing wholesale loops and their areas of operations. The identified companies use a combination of digital microwave radio, SONET rings, and Adark fiber≅ for access to customer buildings, and are concentrated in more dense, urban areas.

TABLE 10: SELECTED CLECs PROVIDING WHOLESALE LOOP FACILITIES

CLEC	**TECHNOLOGY**	**MSA RANKING OF LOCATIONS ( ) = # cities in MSA**
MetroMedia Fiber Networks	Fiber Optics	1,2,3,4,5,6,9,10,11,13
Time Warner Telecom	SONET Fiber Rings	21,30
WinStar Communications	Digital Microwave	1(2), 2, 3, 4(2), 5(2), 6, 7, 8, 9(2), 10, 11, 15, 17, 26 (Planned - 1, 2, 3, 12, 13, 14, 16, 18, 20, 21, 24, 31)

See Appendix A for table sources.

C. Loop Alternatives Are Not Cost Prohibitive To CLECs

CLECs are opting for loop alternatives for several reasons. By providing their own loops, they are taking control of the delivery intervals and quality levels they provide to their customers. In addition, they are able to form partnerships and alliances that allow them to deploy loop functionality efficiently and economically. Michael A. Adams, the President of RCN=s Technology and Network Development Group, has said that ARCN=s unique ability to leverage its alliances with major players in the world of competitive communications and fiber optic network construction represents a significant advantage over both the incumbent phone and cable monopolies, and other competitive providers attempting to serve the residential market.≅[60] RCN=s network Aemploys SONET ring backbone architecture and localized nodes built to ensure RCN=s state-of-the-art fiber optics travel to within 900 feet of RCN customers, with fewer electronics and lower maintenance costs than existing local networks.≅[61]

While not repeated here, the SONET cost and scalability analysis presented in the transport section of this paper is equally applicable to the loop.

[60] *RCN First Quarter Results Highlight Successful Execution of Its Residential Strategy*, PRNewswire, May 4, 1999.

[61] *Id.*

D. CLECs That Choose Alternative Loop Sources Are Experiencing Robust Revenue Growth

The table below demonstrates that CLECs that choose alternative loop sources are experiencing robust revenue growth. The strategy of self-provisioning local loops, or purchasing them from a wholesale provider, is allowing CLECs to grow their customer base, and consequently their revenues.

Table 11: TOTAL REVENUE GROWTH OF SELECTED CLECS THAT PROVIDE THEIR OWN LOOP FACILITIES ($M)

CLEC	**1995**	**1996**	**1997**	**1998**	**% Chg 95 - 98**	**1Q 1999**
21st Century Telecom Group	n/a	n/a	n/a	.94	n/a	1.1
Cox Communications	1,286	1,460	1,610	1,717	33.5%	498.5
Electric Lightwave, Inc.	15.7	31.3	61.1	100.9	543%	38.2
e-Spire	1.2	9.4	59	156.8	12967%	58.1
GST Telecommunications	n/a	41.3	106	163.3	295%	55.7
MediaOne	2,374	2,955	5,043	2,882	21.4%	665
RCN	92.0	104.9	127.3	210.9	129%	67.4
Teligent	n/a	1.4	3.3	1.0	(28.6%)	1.5
Time-Warner Telecom	6.9	23.9	55.4	121.9	1667%	47.6
WinStar	29.8	68	79.6	244.4	720%	88.1

V. Analysis of Operator Service and Directory Assistance Alternatives Available to CLECs

A. CLECs Are Providing Their Own OS/DA Functionality

A facilities-based CLEC is always able to build its own operator network. Switch hardware and software is modular and therefore flexible in matching the CLEC=s service

requirement. In many instances, OS/DA functionality can easily be added to and integrated with a CLECs= current switches. For example, both Nortel=s DMS-500 and the LUCENT 5ESS-2000 switch can be upgraded to accommodate the addition of OS/DA functions. Moreover, equipment suppliers such as Volt Delta, pc-plus INFOMATIK, and IBM offer operator platforms, database systems, and/or search engines to support CLEC network rollout of basic and advanced Directory Assistance services. There are also suppliers that support specific areas of the Toll & Assist and Directory Assistance work functions, whose hardware and/or software can be efficiently and economically integrated into the CLEC=s network and operation. With the addition of readily available work forces and building space, and the already guaranteed non-discriminatory access to ILEC databases, no CLEC is precluded from providing, or even wholesaling, OS/DA.

B. CLECs Are Obtaining OS/DA Functionality From Third-Party Vendors

Many CLECs have chosen to obtain OS/DA services from third-party service providers. The OS/DA technology that exists today provides third-party vendors with the capability to customize their services for each CLEC they serve. Companies providing such services include, but are not limited to, Southern New England (SNET), Sprint, BTI Telecom Services, Century Telecommunications Inc. (CTI), Excel Agent Services, and InteleServ. The major functions provided by these companies are Toll and Assist and National Directory Assistance. These functions are supported by flexible, complementary interfaces to call-related databases such as LIDB, SS7 networks, and intelligent network platforms. These network components can belong to CLECs and CLECs= service providers, as well as to ILECs and IXCs.

Likewise, many service providers offer turn-key systems with automated call processing capabilities. They also provide many options to brand and customize services. These capabilities are enabled by state-of-the-art operator service platforms, databases, and systems. They are supported by trained operator work forces that are available around the clock. CLEC end users can access these services via wireline and wireless network interfaces.

There is also some variety in the services that are available to CLECs. Some service providers specialize in a particular area and expand the product line vertically. Most offer a full portfolio of services and features so that CLECs can choose this functionality as needed to fit their business and market plans. Due to the competitive nature of this business, flexible pricing arrangements and volume discounts are available.

The table below highlights some of the third-party providers that currently offer OS/DA services to CLECs.

TABLE 12: SELECTED THIRD-PARTY PROVIDERS OF OS/DA SERVICES		
SERVICE PROVIDER	**SERVICES PROVIDED**	**GEOGRAPHY**
SNET	Directory Assistance Operator Services	National and Local (Connecticut)
Sprint	Operator Services	Available for customer lines within all local exchanges served by 7 RBOCs, GTE, and Sprint
HebCom	Directory Assistance Operator Services	Local and National DA
InfoNXX	Directory Assistance	National
McLeodUSA	Directory Assistance Operator Services	11 Midwest and Rocky Mountain states
Frontier Communications	Directory Assistance	National
CTI	Directory Assistance Operator Services	Local and National DA
Excell Agent Services	Directory Assistance Operator Services	Local and National DA
InTeleServ	Directory Assistance Operator Services	National
HorizonTelcom	Directory Assistance Operator Services	National
Teltrust, Inc.	Directory Assistance Operator Services	National
Metro One Telecommunications	Directory Assistance	National

C. OS/DA Service Providers That Serve The CLEC Market Are Growing

The OS/DA service providers that cater to the CLEC market are experiencing significant growth as a result of CLEC demand for their services. Table 13 below highlights the revenue growth of some of these companies.

TABLE 13: TOTAL REVENUE GROWTH OF SELECTED PROVIDERS OF OPERATOR SERVICES & DIRECTORY ASSISTANCE ($M)						
Company	**1995**	**1996**	**1997**	**1998**	**% Chg. 95-98**	**1Q 1999**
SNET	1,515.2	1,546.0	1,543.5	Not Available	2% 95-97 only	Not Available
Sprint	12,765.1	14,044.7	14,873.9	Not Available	14% 95-97 only	Not Available
HebCom[62]	2,988.1	3,612.3	4,467.7	5,145.3	72.2%	1,374.0
McLeodUSA	29.0	81.3	267.9	604.1	1,983.1%	181.1
Frontier Communications	2,144.0	2,575.6	2,352.9	2,593.6	21.0%	675.0
CTI[63]	644.8	749.7	901.5	1,577.1	144.6%	414.3
Excell Agent Services	Not Available -- Privately Owned					
InTeleServ	Not Available -- Privately Owned					
HorizonTelcom	34.6	38.0	37.1	41.2	19.1%	11.7
Teltrust, Inc.	33.9	41.1	57.0	132.0	289.4%	33.2
Metro One Tele-communications	13.1	17.8	26.1	45.1	244.3%	14.2

VI. Analysis Of Signaling Alternatives Available To CLECs

CLECs have alternatives to using the ILEC signaling networks and associated call-related databases. Some CLECs are opting to construct and manage their own SS7 networks, while others are obtaining the

[62]Hebcom is a subsidiary of Comcast Corporation. Revenues are for Comcast.

[63]CTI is a subsidiary of Century Telephone Enterprises.

functionality from alternative sources. Whether they build their own networks or purchase services from another party, CLECs have a growing number of options available to them.

A. CLECs Are Providing Their Own Signaling Systems and Associated Databases

CLECs are constructing and managing their own SS7 networks with Signal Transfer Points and appropriate links from their switches. Tekelec -- a leading supplier of SS7 technology -- supplies Signal Transfer Points (STPs) to LECs, IXCs, Enhanced Service Providers (ESPs)and ISPs. From 1992 through the first quarter of 1999, CLECs purchased 32% of the Tekelec STPs sold to LECs. In 1997, CLEC purchases accounted for 23% of the total LEC purchases, growing to 45% in 1998. For the first quarter of 1999, CLEC purchases accounted for 62%.[64]

David Connor, Executive Vice President of Engineering and Chief Technical Officer of US LEC, explained his reasoning for purchasing a pair of STPs from Tekelec for 1999 deployment: AThe STPs will give US LEC more control over network connections, and give us the capability to interface with Advanced Intelligent Network System components in the future. US LEC will no longer depend on other SS7 vendors to connect to the National SS7 network. More important, US LEC=s direct connection to the SS7 network will give our customers the benefit of additional new products and increased network reliability. This is just one more step we are taking to make US LEC the best and most dependable choice for telecommunication services.≅ [65]

CLECs are also going a step further and installing SS7 networks with connections to centralized support tables and databases. Depending on their market plans and customer base, they may also choose to install their own Advanced Intelligent Network platforms. CLECs can integrate their particular database strategies with the signaling network. Overall, CLECs choose the network elements they wish to deploy and interface those provided by others.

---

[64] Information provided by Dean Glenn, Director of Business Development, Tekelec, May 1999.

[65] *US LEC Purchases Signal Transfer Points From Tekelec* US LEC Press Release (April 26, 1999), US LEC Website, www.USLEC.com/press/042699.

One company that has chosen to go this route is GST Telecommunications. In a January 20, 1999 news release, Joe Basile, President and Chief Executive Officer of GST explains: AOwning and controlling our own SS7 network is a key step in our efforts to fully integrate our voice, data, and Internet services. With our own SS7 network we are reducing our reliance on third parties, increasing our speed to market for new services, lowering our operational network costs, and increasing our fraud protection capabilities.≅[66] Mr. Basile further referred to the advanced network and services that GST is deploying: AAs one of the first telecommunications companies to formulate and implement a converged network, we are developing new operating rules . . . It is no longer practical for GST to rely on a third-party for control.≅ [67]

For CLECs, the equipment suppliers for SS7 and AIN networks are the same as those used by RBOCs, ILECs, and IXCs. They include, but are not limited to, Tekelec, Nortel, Alcatel, Lucent, and Siemens. They also include newer players such as Ascend, IEX Corporation (NEXUS), and SummaFour (Cisco). In some instances, a CLEC can mix and match vendor elements because they are based on standard interfaces and protocols. As new products are announced, there is a growing emphasis on converged networks and IP telephony.

In sum, as the number and size of service providers continues to increase, more are building their own SS7 networks. There are many products available for providers that choose to self-provision. As CLEC and ISP networks converge on single networks, more service providers will have the same incentives as US LEC and GST to build and manage their signaling systems.

B. CLECs Are Obtaining Signaling and Call-Related Database Capabilities From Alternative Sources

An increasing number of CLECs are opting to obtain their SS7 functionality from alternative service providers. These service providers offer the CLECs nationwide access and interconnection to SS7 networks, access to and storage of telephone numbers, customer databases and related services, and call set-up and management. Specific capabilities purchased by CLECs include routing, access, transport, validation, storage,

---

[66] *GST Telecommunications Completes SS7 Network Infrastructure* GST Communications, Inc. News Release (Jan 20, 1999), GST Website, www.gstcorp.com/investor.

[67] *Id.*

and fraud protection. Connections are made directly into a service provider=s network, or through a gateway to other major networks and service providers. Interconnections are nationwide, with options for access to overseas databases and networks.

Service companies providing SS7 network connectivity do so via redundant, state-of-the-art Signal Transfer Points (STPs). STPs are located in different regions of the country, and are accessible to CLECs regardless of the state from which they offer service. In many instances, the SS7 service providers also offer the physical links to the SS7 network elements, with full provisioning and maintenance support. Initial access permits entry into the SS7 networks of other telecommunications service providers, including RBOCs/ILECs, IXCs, and wireless networks. Some CLECs are establishing business relationships with their service providers. For example, ICG Telecom has strategic agreements with its key communication service providers: AThrough our partnership with Southern New England Telephone, ICG became the first CLEC with a nationwide SS7 network, an important component for interconnecting local telephone companies with long distance carriers.≅[68]

With SS7 access, these service providers connect the CLEC to call-related databases for the storage and retrieval of telephone number and customer-related data, including LIDB and 800 Service. For most providers, the portfolio also includes support for Local Number Portability, Customer Name Services, and Single Number Services. Connections are established with all necessary regional centers and databases. These capabilities are frequently built on Intelligent Network (IN) or Advanced Intelligent Network (AIN) platforms. There are a number of service providers that support the development, testing, and delivery of advanced and customized features for CLECs. This can be done in a secure service creation environment by the CLEC, with specialists from the service provider, or jointly. There are also options for CLECs to purchase AIN links to third-party service providers if they choose to use them. Thus, there are a number of choices of state-of-the-art service providers, as indicated in the table below.

TABLE 14: THIRD-PARTY PROVIDERS OF SS7, DATABASE, AND AIN SERVICES

PROVIDER	SERVICE	GEOGRAPHY
Illuminet	SS7 Network Service	National
	Call Related Databases	National
	AIN Services	National

[68] *ICG Telecom Group Mission,* ICG Website, located at www.icgcom.com.

TABLE 14: THIRD-PARTY PROVIDERS OF SS7, DATABASE, AND AIN SERVICES		
SNET	SS7 Network Services Call Related Databases AIN Services	National National National
GTE Intelligent Network Services	SS7 Network Services Call related Databases AIN Services and AIN links to 3rd parties	Access to/from most LATAs National National; IXC connections negotiated individually
BTI	SS7 Network Services	East coast focus, but can connect nationally
TNSI Telecom Division Services	SS7 Network Services LNP	National National plus Canada
NaviNet	SS7 for Internet Dial-up Applications	National
Revcom	Independent LIDB for CLECs; Supported with own SS7 network	National
Targus Information Corp	AIN Services (includes SS7 transport for services provided)	National

Significant growth in the number of CLECs has stimulated demand for SS7 Network, Call-Related Databases and Intelligent Network related services -- which has had a positive effect on the development of a competitive marketplace. Customer specific pricing and contracts are negotiated for these services. Discounts are usually provided based on the number of services provided and the volume of transactions. Because this is a highly competitive area with multiple players, pricing information is not publicly available.

The table below provides a sampling of the revenue growth for some of the service providers discussed above.

TABLE 15: TOTAL REVENUE GROWTH OF SELECTED PROVIDERS OF SS7, DATABASE, AND AIN SERVICES ($M)

Company	**1995**	**1996**	**1997**	**1998**	**% Chg. 95-98**	**1Q 1999**
Illuminet	17.1	37.9	54.3	Not Available	217% 95-97	Not Available
SNET [69]	1,515.2	1,546.0	1,543.5	Not Available	2% 95-97	Not Available
BTI Telecom Services	114.5	148.8	194.9	212.6	85.7 %	56.1
TNSI Telecom Division Services[70]	41.4	52.3	63.3	101.9	146.1 %	38.2
NaviNet [71]	22.3	28.5	70.6	91.5	310.3 %	40
Revcom	Privately Owned					
Targus Information Group	Privately Owned					

[69]SNET merged with SBC Corp. In 1998.

[70]TNSI is a subsidiary of Transactio Network Servie and consolidated revenues are shown.

[71]NaviNet is a subsidiary of CMGI, Inc. and consolidated revenues are shown.

C. The Success Of CLECs In Deploying SS7 Alternatives Is Evident

The table below provides the revenue growth of selected CLECs that are taking advantage of the SS7 alternatives available in the marketplace today. It is evident from the information contained in the table that CLECs that use their own SS7 networks are growing at very rapid rates.

TABLE 16: TOTAL REVENUE GROWTH OF SELECTED CLECs THAT USE SS7 ALTERNATIVES ($M)

Company	**1995**	**1996**	**1997**	**1998**	**% Chg. 95-98**	**1Q 1999**
GST	n/a	41.3	106	163.3	295%	55.7
US LEC	n/a	n/a	6.5	84.7	1203%	36.2

VII. Analysis Of The Operations Support Systems Alternatives Available To CLECs

The FCC originally required the ILECs to provide CLECs an electronic gateway into their existing computer systems to facilitate timely pre-ordering, ordering, provisioning, and trouble administration of all UNEs.[72] In addition, the ILECs had to provide a method for the CLECs to render accurate billing information to the CLECs (and vice versa) in order to facilitate reciprocal billing. The system for providing access to repair, provisioning, and billing systems comprises a platform that is commonly referred to as Operations Support Systems. OSS functionality allows service representatives from a CLEC=s customer care centers real-time access to these systems and enables them to respond to customer inquiries and demand on-line.

Today, there are OSS alternatives available to CLECs. CLECs are opting to utilize their own OSS gateway, or purchase OSS capability from third-party vendors. These platforms provide CLECs with a level of efficiency that is at least equal to the service offered to retail ILEC customers, and in many cases superior. Since there are viable alternatives for this network element, ILECs should be required to provide OSS unbundling only in those instances where CLECs use the OSS in conjunction with another ILEC

[72] 47 C.F.R. ∋51.319(f)(1)(1998).

service or element.

A. CLECs Are Opting For Vendor Provided OSS Functionality

Many CLECs choose to obtain their OSS functionality from one of the myriad of vendors that now supply the OSS features and functions required by CLECs to serve their customers efficiently and without service delays. Facilities-based CLECs, such as AT&T Local Services (formerly Teleport), have purchased hardware and software solutions from private vendors to help them manage their Customer Care Centers. They have incorporated Harris Corporation=s Remote Test Unit (RTU) Models 105 and 107 and CTS-6000 Test Administration Systems into their collocation cages and customer sites in order to remotely perform testing of unbundled loops and trunks. The features of these units include thorough, accurate subscriber loop testing, automatic loop testing of the entire cable plant, automatic number identification, and office alarm monitoring.[73]

MCI, on the other hand, was an early user of Gensym=s Intelligent OSS (G2), a second-generation platform that provides support of their complex and growing invoice and auditing needs. With G2, MCI could graphically represent the entire billing process, capture auditor knowledge through rules and procedures, and validate each step of the process. And France Telecom, France=s leading telephone provider, implemented an intelligent OSS called Experviseur for better management of telephone network traffic. Also based on Gensym=s G2 software, Experviseur receives alarms, filters out extraneous alarms, and proposes corrective actions to maintain the quality and operability of the network.[74] With Gensym=s Intelligent OSS, levels of scalability are being achieved that meet today=s demands and support the growth potential necessary for tomorrow. Other foreign carriers are utilizing Experviseur and other similar technologies.

Innovative cable companies that have elected to enter the telecommunications arena have built software that overlays their existing CATV service request, trouble administration, and network surveillance systems. Last year, MediaOne, the third largest cable provider in the United States, developed and deployed Enterprise Ticketing Engine (ETE), an overlay to their existing OSS network. ETE allows service attendants to better

[73] Harris Corp Website http://www.harris.com/test-mgmt/lts.

[74] *Gaining Competitive Advantage with Intelligent OSS* (Advertisement), tele.com (Dec.1998).

manage trouble ticket administration and initiate intrusive fiber and coax testing, and also provides a vehicle to track and manage customer service orders.[75] This overlay better positions MediaOne to offer telephone service successfully to its existing CATV base. Other cable companies have implemented similar internal or vendor provided solutions in preparing to enter the markets for voice and data services.

B. Software Vendors Are Catering To The CLEC Market

Many software and hardware manufacturers have anticipated the expanded need for OSS solutions to satisfy the growing demands of CLEC customer bases. The development of Telecommunications Management Network (TMN) architectures, principles, and products across the telecom industry has eased the manufacturer=s problem of integrating its software solutions into the ILEC legacy systems, and thus has created a fertile market for new OSS development.

[75]Telephone Interview with former Operations Manager of MediaOne, Boston, Mass. (March 11, 1999).

For example, Telcordia, formerly Bellcore, will introduce the world=s first comprehensive suite of carrier grade OSSs for Next Generation Networks within the next twelve months. Telcordia=s OSS/NGN suite will assist CLECs in supporting automatic provisioning, service assurance, service activation, and network management. In anticipation of emerging technologies, the product will operate in Adual-mode≅ supporting both IP-based as well as circuit-based networks. In addition, Telcordia has recently announced a new software package -- MediaVantage7 JumpStart,ϑ which is scheduled for release in the second quarter of 1999 -- that allows start-up CLECs to seamlessly integrate into an ILEC network. It provides a CLEC with rapid basic functionality, and allows for affordable, scalable growth.[76] The software runs on the Microsoft Windows NT7 operating system, a common cost-effective LAN system used in many corporate environments. Telcordia has also partnered with Nortel Networks to develop a product that will help communications service providers transform their existing circuit-switched networks into hybrid packet networks through the integration of Telcordia=s cross domain OSS.[77]

Lucent Technologies offers a suite of operations software solutions that support entire service management processes from network creation to service assurance and maintenance. ACTIVIEW7 Service Management Software enables service providers to respond to customer requests more quickly, reliably, and at less cost by simultaneously checking, synthesizing, and processing thousands of customer requests.[78] Lucent also offers Service Readyϑ Starter Solutions to start-up CLECs that are sized and priced appropriately for growing networks. These entry-level solutions have the same characteristics of the proven Lucent products that are used by large telecommunications service providers worldwide.[79]

---

[76] http://www.telcordia.com/newsroom/pressreleases/981202jumpstart.html.

[77] clec.com,http://www.clec.com/latest/oss99/oss99story2.cfm.

[78]Lucent Technologies Website, http://www.lucent.com/OS/.

[79]*Release the Power of Your Growing Network..Service Readyϑ Starter Solutions*, Lucent Marketing Communications Brochure, No 5319, Issue 02 (Jan. 1999) at 2 (see www.lucent.com/software).

As a CLEC=s network expands, the software can be scaled to accommodate growth. Switched Access Remote Test System (SARTS) is an operations system that provides easy, accurate remote testing for an entire multi-vendor network ranging from one circuit to more than 100,000. The system can consolidate circuit testing and maintenance for both high-capacity digital services -- including private network, broadband, data, dedicated switched services, and intelligent network services -- and analog resources, such as twisted pair.[80] SARTS allows a CLEC to perform remote intrusive testing of its own local loops and switched access circuits, without assistance from the local exchange carrier.

Other OSS vendors, such as Saville, offer customer care solutions to CLECs. Saville CBP7 provides telecommunications companies with the ability to achieve total customer management. Modules of Convergent Billing Platform address all aspects of customer care including Service Order Management, Marketing, Discounting, Event Processing Manager, Billing, Post Billing, and Product Ordering. All of these modules work together to create a customer-specific database. Saville CBP7 achieves fully convergent customer management, at reasonable costs and without disrupting legacy systems.

Daleen=s Billplexϑ is a next generation convergent billing and customer care software solution that integrates billing, provisioning, and customer care for multiple usage-based systems. Daleen offers rapid system implementation and service maintenance while simultaneously controlling development costs.[81] Billplex=s seamless scalability supports start-up operations through mature, established carriers. It enables providers the flexibility to initially offer a single or multiple services, as well as the ability to easily add services without requiring a technical redesign or a large development effort.[82] OnSite Access, a Clark, NJ based ISP, announced on January 25, 1999, that it has have selected the Billplex family of products: ABy offering a consolidated billing service, OnSite Access will now provide cross-product discounts as well as a more flexible pricing structure to its customers.≅[83]

---

[80]Lucent Technologies Website, http://www.lucent.com/OS/, at 4.

[81]Daleen Technologies Website, http://daleen.com/billplex/bintro.html.

[82]*Id.*

[83]Daleen Technologies Website, http://www.daleen.com/in_the_news.

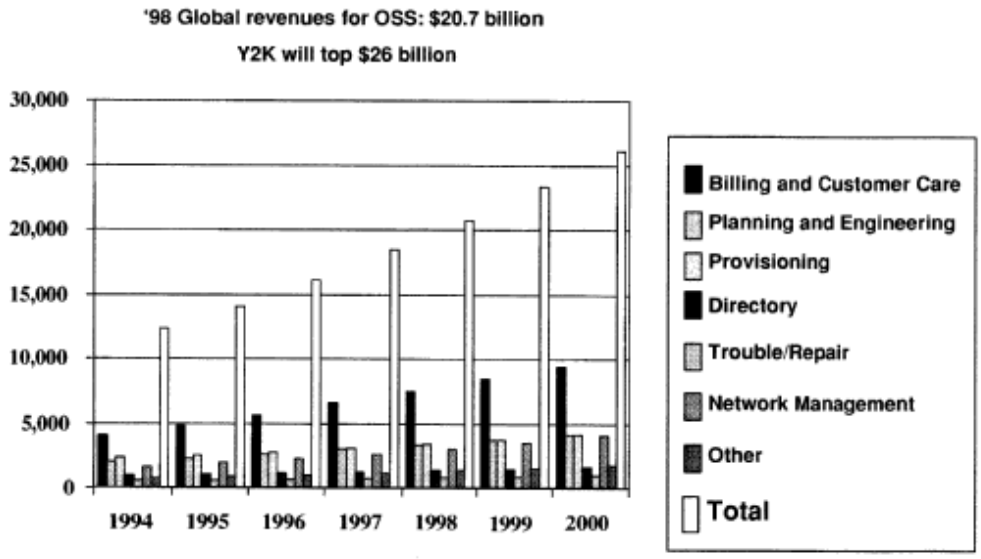
Eftia OSS Solutions, Inc. also offers a suite of scalable products to manage today=s telecommunications networks. Eftia d.Scribe Inventory℠ is designed to build and maintain comprehensive models of telecommunications networks, by accurately and efficiently recording changes to transport facilities and network elements as they are implemented.[84] d.Scribe℠ tracks consumed and available bandwidth, identifies circuit relationships, and incorporates relevant site and device information. It provides instant access to circuit information for all facility types, location information for all POPs, and device information for all network components -- including switches, MUXs, DSU/CSU, and CPE -- as well as device locations of shelved components, cards, and ports.

In addition, many software development companies have partnered with electronic gateway developers to offer off-the-shelf software solutions that can easily be integrated into an ILEC=s OSS at reasonable costs. An example is the partnership between Beechwood, a provider of system integration expertise, and Daleen Technologies, the developer of BillPlex℠ convergent billing and customer software. This relationship has resulted in elevated sales to CLECs.

The above product lines are all geared to accommodate the needs of the entry-level telecommunications company that provides all or some of their own network components.

[84]Eftia Website, http://www.eftia.com/solutions/telecom/invent.htm.

The graph below demonstrates the tremendous growth that has occurred and is expected to occur in the OSS industry. As indicated, global revenues for OSS are projected to exceed $18.5 billion in 1998. And by the year 2000, they are projected to exceed $26 billion, up from less than $12 billion in 1994.[85]



The Global OSS Market

The table below depicts an overview of several of the many manufacturers that have entered the market to provide OSS and/or gateway solutions to the CLEC, CAP, and CATV industries.

TABLE 17: MANUFACTURERS OF OSS/GATEWAY SOLUTIONS			
MANUFACTURER	**PRODUCT**	**MARKET**	**SOLUTION**
Harris Communications	HLTS, 105A and107A	Birch Telecom (CLEC), Aliant (ISP)	Remote XDSL Line Testing
Micromuse, Inc.	Netcool	Allegiance (CLEC), NTL, Inc. (ISP, CLEC)	Manage Voice and Data Switching Systems
Intelligent Electronics and Eftia OSS Solutions, Inc.	MasterScribe	NewSouth, others (CLECs	Automatically schedule systems to Provision Service and manage

[85] *OSS Interconnection: Breakthrough or Burden?* The 1999 Local Loop Comprehensive Report (ICC publication).

TABLE 17: MANUFACTURERS OF OSS/GATEWAY SOLUTIONS			
			Trouble Administration
Telcordia Technologies	OSS/NGN	Videotron (CATV)	Provisioning of Voice and Data over COAX, VOIP.
Ascend	Advantage Plus	CLECs, ISPs	On line self-help OSS to manage Ascend Hardware and Software Products
INRANGE	ClecT	CLECs	Network Monitoring System for SS7 Surveillance, Monitor and Test System for DS1 to OC3
DSET	ILEC in a Box	Ovation Communications (CLEC)	LSR Order Gateway and Local Service order Administration, E911, LIDB, and CNAM Gateways
Eftia	n.Scribe	PaeTec (CLEC)	Manages Phone Number Assignments in NPA-NXX
Wisor Telecom	C-LEC	CLECs	Order Management, Order Entry Inventory, Provisioning
ACE*COM	ACE*COM	CLECs	Number Administration Systems
ENA		CLECs	Bridge Between Newly Developed OSSs and Legacy Systems
PCR, Inc.	E-SYS	CLECs	Fully integrated OSS with Convergence Billing, Provisioning, and Customer Care Management
IBM		ICG Comm. (CLEC)	Customer Care and Billing System
BEA Systems	Weblogic Java OSS	Covad	Application Deployment, Online Service Upgrades
EDS	EDS Management	BTI (CLEC)	Billing and Product Management Software

TABLE 17: MANUFACTURERS OF OSS/GATEWAY SOLUTIONS			
Telcordia and Nortel	Next Generation Network OSS/Succession	Circuit based CLECs migrating to Data CLECs	Integrated Inventory Assignment, automating design and assignment of tasks across hybrid networks.
See Appendix A for table sources.			

Many of the solutions offered by the companies listed above also include support for new forward-looking technologies. For instance, the Harris Line Test System is an OSS that provides a full suite of test, installation, maintenance, and surveillance tools, and also offers Carrier Test Access Switch (CTAS) to test the viability of local loop conditioning for ADSL offerings.[86]

The above mentioned companies, and scores more, have developed solutions to better manage all the pre-ordering, ordering, provisioning, maintenance, and billing requirements of CLECs. As a result, CLECs have a host of methods to interact with the ILECs in all necessary areas. And many customer care software platforms are available. The platforms offer cost-effective, scalable solutions for CLECs that opt to purchase their own switches, interoffice connectivity, and local access.

VIII. CLECs Are Securing Funding From The Investment And Vendor Communities

The success of CLECs that deploy their own infrastructures is evident in the massive amount of capital funding they are receiving from the investment and vendor communities. This funding is being provided by venture capitalists, equipment vendors, and through stock offerings and lines of credit. In addition, numerous partnerships are being formed between facilities-based CLECs and other companies. Attachment F highlights some of the investment and partnering activity that has occurred early in 1999. These deals highlighted below have all transpired between the investment and vendor communities and CLECs that self-provision some or all of their network functionality. This attachment provides a clear indication that there is a high level of confidence in the viability of facilities-based CLECs.

[86] Harris Corp Website, http://www.harris.com/harris/whats_new/xdsl-comm.html.

I declare under penalty of perjury that the foregoing, which was prepared under my direction, is true and correct.

Executed on May 24, 1999.

_____

Francis J. Murphy
President
Network Engineering Consulting, Inc.

APPENDIX A

Table 1: Selected Traditional CLECs Providing Their Own Switch Facilities

21st Century. http://stn.siemens.com/icn/news/1998/98060406.html. **Allegiance Telecom.** http://www.allegiance.com/body_Lucent.html. **AT&T Local.** http://www.tcg.com/tcg/media/PRcurrent/attfinal.html. **BayRing Communications.** http:www.bayring.com/company.htm. **Birch Telecom.** http://www.birchtel.com/020598.html. **Business Telecom, Inc.** http://www.btitele.com/new/release.cgi? **CapRock Communicaitons** www.caprock.com/pages/news?Caprokcfinal.htm;l **Electric Lightwave.** http://www.eli.net/about.html. **e.spire.** http://206.222.96.19/corporate/index.cfm. **FirstWorld Communications.** http://www.firstworld.com/news/archives/. **Florida Digital Network.** http://www.floridadigital.net/network.htm. **Focal Communications Corporation.** http://www.focal.com/prod_serv/telecom_serv.html. **Frontier Communications.** http://www.frontiercorp.com/about/news/199931-920305201.html. **GCI.** http://www.gci.com/about/index.htm. **GST Pacific.** http://www.gstcorp.com/products.html. **Hyperion Communications.** http://www.hyperioncom.net/html/products/. **ICG Communications.** http://www.icgcom.com/corporate/default.htm. **Intermedia Communications.** http://www.intermedia.com//products/services.html. **ITC^DeltaCom.** http://www.itcdeltacom.com/news/. **KMC Telecom.** http://www.kmctelecom.com/news/releases/feb4-99.html. **Justice Technology.** http://www.justicecorp.com/main/carrier/switch.htm. **McLeodUSA, Inc.** http://www.mcleodusa.com/BusinessProducts/default.html. **MCI WorldCom.** http://www.wcom.com/about_the_company/corporate_overview/. **MGC Communications.** http://www.clec.com/latest/ClecNesSearch.cfm. **NewSouth Communications.** http://www.newsouth.com/site91498/HTML/strategy.html. **NEXTLINK** www.nextlink.net/ra/info/racompback.ground.html. **Pac-West Telecom.** http://www.pacwest.com/company/overview.cfm. **PaeTec Comm.** http://www.paetec.com/WWWSite/network1.html. **US LEC.** http:///www.uslec.com/ **TelePacific.** http:///www.telepacific.com/docs/about.htm.

Table 2: Selected CLECs Providing Switches in Small MSAs

AT&T Local. http://www.tcg.com/tcg/media/PRcurrent/attfinal.html**. GCI.** http://www.gci.com/about/index.htm. **Hyperion Communications.** http://www.hyperioncom.net/html/products/. **KMC Telecom.** http://www.kmctelecom.com/news/releases/feb4-99.html. **McLeodUSA, Inc.** http://www.mcleodusa.com/BusinessProducts/default.html. **MCI WorldCom.** http://www.wcom.com/about_the_company/corporate_overview/.

Table 3: Selected CATV CLECs Providing Their Own Switch Facilities

Cablevision Systems (Lightpath). http://www.cablevision.com/cvhome/frame/. **Cox Telecom.** http://www.cox.com/telephone/ **MediaOne Telecommunications.** http://www.mediaone.com/products_services/ **RCN Corporation.** http://www.clec.com/latest/clecnews.cfm/rcn. **Time-Warner Telecom.** http://www.clec.com/latest/clecnews.cfm/time warner.

Table 4: Selected Wireless CLECs Providing Their Own Switch Facilities

AT&T Local. http://www.tcg.com/tcg/media/PRcurrent/attfinal.html. **McLeodUSA, Inc.** http://www.mcleodusa.com/BusinessProducts/default.html. **Teligent.** http://www.teligent.com/ **WinStarWireless.** http.www.clec.com/latest/clecnews.cfm. Keyword=winstar.

Table 6: Total Revenue Growth of Selected CLECs Who Provide Their Own Switching Functionality

Revenue Source: **21st Century Telecom Group.** http://www.21stcentury.com/20.html, http://www.21stcentury.com/ 19.html. **Allegiance Telecom.**http://www.hoovers.com/premium/annuals/57346af.html. http:// www.hoovers.com/premium/quarterlies/57346qe.html. **Bell Atlantic Mobile.** http:www.edgar-online.com/bin/getsec/index.pl?doc=A-732712-0000950109-99-001134. http:www.edgar-online.com/bin/getsec/index.pl?doc=A-732712-0001036050-99-001035. **BellSouth Corporation.** http:www.edgar-online.com/bin/getsec/index.pl?doc=A-732713-0001047469-99-007204. http:www.edgar-online.com/bin/getsec/index.pl?doc=A-732713-0000732713-99-000006. **Birch Telecom** http://www.birchtelecom.com/020899.html. http://www.birchtelecom.com/051399.html. **BTI** . Consolidated Statements Of Operations. http://www.btitele.com/news/release/3/1/99.com. **Cablevision Systems (Lightpath)** http://www.hoovers.com/premium/premium/fin-tables/11792ft.html, http://www.cablevision.com/cvhome/cvabout/news/1q99.htm..**CommNet Cellular** www.hoovers.com/ premium/fin_tables/15401ft.html. **Cox Communications.** http:// www.hoovers. com/premium/ fin_tables/43269ft.html. www.hoovers.com/premium/quarterlies/ 43269ft.html. **Electric Lightwave** http://www.hoovers.com/premium/fin_tables/54535ft.html. www.hoovers.com/premium/ quarterlies/54535qe.html. **e-Spire**. http://www.2.espire.net/investor/ annualrpts/97annualreport/pages/ fiscal.cfm. **FirstWorld.** http://www.firstworld.com/news/archives/12-21-98.html. http://www.firstworld.com/newsSearch.cfh. http://www.firstworld.com/news/index.html. **Focal Communications** http://www.focal.com/news/1999/02/17/pr01.html. http://www.focal.com/news/1999/04/226/pr01.html. **Frontier Communications.** www.hoovers.com/premium/ fin_tables/11281ft.html. www.hoovers.com/premium/ quarterlies/11281ft.html. **GCI of Alaska (General Communications)**. http://gci.com/about/press/99_release.htm. http://gci.com/about/press/fin96.htm http://gci.com/about/ press/98_release.htm. **GST Telecommunications**. http://www.clec.com/latest/ ClecNewsSearch.cfm. **Hyperion Communications** http://www.hoovers.com/ premium/ fin_tables/52486ft.html. http://biz.yahoo.com, 5/21/99. **ICG Communications.** http://www.icgcomm.com/ investor/annual97/ annual97_page_19htm. http://www.clec.com/latest/ClecNewsSearch.cfm. **Intermedia Communications**

http://www.hoovers.com/annuals/15637af.html. http://www.hoovers.com/annuals/ 15637qe.html. 1996 Intermedia Company Report. **ITC DeltaCom** http://www.hoovers.com/premium/fin_tables/ 54655ft.html. http://www.hoovers.com/premium/quarterlies/ 54655ft.html. **McLeodUSA** http://www.mcleodusa.com/investorrelations/98annualreport/financialhighlights.html. **MCI WorldCom.** http://www.hoovers.com/premium/fin_fintables/58340ft.html. http://www.hoovers.com/premium /quarterlies/58340ft.html. **MediaOne** http://www.hoovers.com/premium/ quarterlies/ 47905qe.html http://www.hoovers.com/premium/ fin_tables/47905qe.html **MGC Communications** http://www.hoovers.com/premium/ quarterlies/56573qe.html http://www.hoovers.com/premium/ fin-tables/56573qe.html **Pac-West Telecom** http://pacwest.com/company/newstand/qrtlyrpts/1Q99.cfm http://pacwest.com/company/newstand/qrtlyrpts/4Q98.cfm **RCN** http://www.hoovers.com/ premium/fin_tables/54614ft.html http://www.hoovers.com/ premium/quarterlies/54614ft.html **Teligent** http://www.hoovers.com/ premium/fin_tables/53894ft.html http://www.hoovers.com/ premium/quarterlies/ 53894ft.html. http://www.teligent.com/investor/TeligentARWeb/fdata97.asp **Time-Warner Telecom** http://www.hoovers.com/premium/fin_tables/56589ft.html http://www.clec.com/latest/ClecNewsSearch. cfm. **US LEC** http://www.hoovers.com/premium/fin_tables**/**56076ft.html http://www.hoovers.com/premium/quarterlies**/**56076qe.html **WinStar Communications** http://www.hoovers.com/premium/quarterlies**/**46398qe.html http://www.hoovers.com/premium/ fin_tables/46398ft.html

Table 7: Selected CLECs Providing Their Own Transport Facilities

Transport Alternatives: Allegiance. www.allegiancetele.com/in_the_news.html. **AT&T Local.** www.att.com/network/. **Bay Ring Communications.** www.bayring.com/company.htm. **Birch Telecom.** From ABirch Telecom Acquires Capital GBS Communications≅ Press release of March 5, 1999, www.birch.com/030599.html. **BTI Telecommunications Services, Inc.** www.btitele.com/fiber.html. **Cablevision Systems.** www.cablevision.com/cvhome/frame/fphone.htm. **Caprock.** www.caprock.com/pages/news/CRExpansion.html, www.caprock.com/pages/news/EnronFinalII.html. **Electric Lightwave.** From AElectric Lightwave, IXC Extend Networks With $178 Million Fiber Exchange≅, press release on 4/13/99. **e-spire.** www2.espire.net/press/index.cfm. **FirstWorld.** www.firstworld.com/networks/index.html. **Focal Communications.** www.focal.com/about/service_areas.html. **Frontier.** www.frontier.com/optronics/mapplication/. **FTV Communications.** From Williams press release dated 10-19-98 AWilliams Network Expands West Coast by Nearly 1500 Miles in Fiber Exchange and Purchase≅. **GST Pacific.** www.willtales.com/network/pressreleases/rel65.html. **Hyperion Communications.** www.hyperioncom.net/html/corp/. **ICG Communications.** cgcomm.com/news/releases/1998. **Intermedia Communications.** www.intermedia.com/company/press**. ITC^DeltaCom.** www.deltacom.com/network_map.html. **KMC Telecom Corporation.** www.kmctelecom.com/cities/cities.html. **Level 3.** www.level3.com/CompanyNews/news_releases.html. **McLeodUSA, Inc.** www.mcleodusa.com/BusinessProducts. **MCI Worldcom.** www.lwcom.com/about_the_company/. **MediaOne Telecommunications.** www.mediaonegroup.com/whatweoffer**. PaeTec.** www.paetec.com/WWWSite/network(x).html. **Qwest.** www.qwest.net/network/mainmaps.html. **RCN.** www.rcn.com/investor/press, www.rcn.com/about_rcn/main_about_rcn.html. **Teligent.** www.teligent.com/about_our_network.asp. **Time-Warner.** www.pathfinder.com/corp/fbook/fbcable.html. **Touch America.** www.tamerica.com/about_us. **WinStarWireless.** www.winstar.com/Newsroom_Display.html.

Table 8: Total Revenue Growth of Selected CLECs Who Provide Their Own Transport Facilities

Revenue Source: **Allegiance Telecom.**http://www.hoovers.com/premium/annuals/57346af.html. http:// www.hoovers.com/premium/quarterlies/57346qe.html. **Birch Telecom** http://www.birchtelecom.com/020899.html. http://www.birchtelecom.com/051399.html. **BTI** . Consolidated Statements Of Operations. http://www.btitele.com/news/release/3/1/99.com. **Cablevision Systems (Lightpath)** http://www.hoovers.com/premium/premium/fin-tables/11792ft.html, http://www.cablevision.com/cvhome/cvabout/news/1q99.htm. **CapRock Communications** http://www.hoovers.com/premium/annuals/ 58336af.html http://www.hoovers.com/premium/quarterlies/58336qe.html **Electric Lightwave** http://www.hoovers.com/premium/fin_tables/54535ft.html. www.hoovers.com/premium/ quarterlies/54535qe.html. **e-spire**. http://www.2.espire.net/investor/ annualrpts/97annualreport/pages/ fiscal.cfm. **Firstworld.** http://www.firstworld.com/news/archives/12-21-98.html. http://www.firstworld.com/newsSearch.cfh. http://www.firstworld.com/news/index.html. **Focal Communications** http://www.focal.com/news/1999/02/17/pr01.html. http://www.focal.com/news/1999/04/226/pr01.html. **Frontier Corporations.** http://www.hoovers.com/premium/ fin_tables/11281ft.html. www.hoovers.com/premium/ quarterlies/11281ft.html. **GST Telecommunications**. http://www.clec.com/latest/ ClecNewsSearch.cfm. **Hyperion Communications** http://www.hoovers.com/ premium/ fin_tables/52486ft.html. http://biz.yahoo.com, 5/21/99. **ICG Communications.** http://www.icgcomm.com/ investor/annual97/ annual97_page_19htm. http://www.clec.com/latest/ClecNewsSearch.cfm. **Intermedia Communications** http://www.hoovers.com/annuals/15637af.html. http://www.hoovers.com/annuals/ 15637qe.html. 1996 Intermedia Company Report. **ITC DeltaCom** http://www.hoovers.com/premium/fin_tables/ 54655ft.html. http://www.hoovers.com/premium/quarterlies/ 54655ft.html. **McLeodUSA** http://www.mcleodusa.com/investorrelations/98annualreport/financialhighlights.html. **MCI WorldCom.** http://www.hoovers.com/premium/fin_fintables/58340ft.html. http://www.hoovers.com/premium /quarterlies/58340ft.html. **MediaOne** http://www.hoovers.com/premium/ quarterlies/ 47905qe.html http://www.hoovers.com/premium/ fin_tables/47905qe.html **RCN** http://www.hoovers.com/ premium/fin_tables/54614ft.html http://www.hoovers.com/ premium/quarterlies/54614ft.html **Teligent** http://www.hoovers.com/ premium/fin_tables/53894ft.html http://www.hoovers.com/ premium/quarterlies/ 53894ft.html. http://www.teligent.com/investor/TeligentARWeb/fdata97.asp **Time-Warner Telecom** http://www.hoovers.com/premium/fin_tables/56589ft.html http://www.clec.com/latest/ClecNewsSearch. cfm. **WinStar Communications** http://www.hoovers.com/premium/quarterlies**/**46398qe.html http://www.hoovers.com/premium/ fin_tables/46398ft.html.

Table 9: Selected CLECs Providing Their Own Loop Facilities

Source: AT&T http://www.clec.com/latest/directorybody.cfm?CompanyID=18 **Cox Communications** http://www.cox.com/Area/ **Electric Lightwave** http://www.clec.com/latest/ClecNewsSearch.cfm http://www.eli.net/home.html **e-Spire** http://www2.espire.net/index2.cfm http://www.clec.com/ latest/clecnews.cfm **GST Telecommunications** http://www.gstcorp.com/

locations.html http://www.clec.com/latest/ClecNewsSearch.cfm **Logix** http://cco.cisco.com/warp/public/146/ june98/17.html **MediaOne** http://www.mediaone.com/ http://www.clec.com/latest/clecnews.cfm **NextLink** http://www.nextlink.net/tx/nx1/nx1news.html http://www.nextlink.net/tn/tnstatemap.html http://www.nextlink.net/fl/flstatemap.html http://www.nextlink.net/pa/pastatemap.html http://www.nextlink.net/ca/castatemap.html http://www.nextlink.net/tx/txstatemap.html http://www.nextlink.net/ga/gastatemap.html http://www.nextlink.net/oh/ohstatemap.html **McLeodUSA** http://www.mcleodusa.com/ **RCN** http://www.rcn.com/ **Time Warner** http://www.twtelecom.com/ TimewarnerCities/index.html http://www.twtelecom.com/AboutTWC/index.html http://www.twtelecom.com/ProductsServices/index.html **Teligent** http://telegent.com/default-about.asp http://telegent.com/markey/pacific.asp http://telegent.com/market/midwest.asp http://telegent.com/market/west.asp http://telegent.com/market/east.asp http://telegent.com/market/ south.asp **Touch America** http://mpc.in-tch.com:30080/headlines/1999_Releases/02-22-99.html **Winstar** http://www.winstar.com/Home_Display.htm http://www.winstar.com/BuiServ_Display.htm http://www.clec.com/latest/body.cfm

Table 10: Selected CLECs Providing Wholesale Loop Facilities

Metromdia Fiber Networks www.clec.com/latest/CLECNewsSearch.cfm. **Time Warner Telecom** www.clec.com/latest/CLECNewsSearch.cfm.**WinStar Communications** www.winstar.xom/CarrServ_Display.htm.

Table 11: Total Revenue Growth of Selected CLECs Who Provide Their Own Loop Facilities

Source: **21st Century Telecom Group .** http://www.21stcentury.com/20.html, http://www.21stcentury.com/ 19.html. **Cox Communications.** http:// www.hoovers. com/premium/ fin_tables/43269ft.html. www.hoovers.com/premium/quarterlies/ 43269ft.html. **Electric Lightwave** http://www.hoovers.com/premium/fin_tables/54535ft.html. www.hoovers.com/premium/ quarterlies/54535qe.html. **e-Spire**. http://www.2.espire.net/investor/ annualrpts/97annualreport/pages/ fiscal.cfm.. **GST Telecommunications**. http://www.clec.com/latest/ ClecNewsSearch.cfm.. **MediaOne** http://www.hoovers.com/premium/ quarterlies/ 47905qe.html http://www.hoovers.com/premium/ fin_tables/47905qe.html **RCN** http://www.hoovers.com/ premium/fin_tables/54614ft.html http://www.hoovers.com/ premium/quarterlies/54614ft.html **Teligent** http://www.hoovers.com/ premium/fin_tables/53894ft.html http://www.hoovers.com/ premium/quarterlies/ 53894ft.html. http://www.teligent.com/investor/TeligentARWeb/fdata97.asp **Time-Warner Telecom** http://www.hoovers.com/premium/fin_tables/56589ft.html http://www.clec.com/latest/ClecNewsSearch. cfm. **WinStar Communications** http://www.hoovers.com/premium/quarterlies**/**46398qe.html http://www.hoovers.com/premium/ fin_tables/46398ft.html

Table 12: Third-party Providers of OS/DA Services

SNET. Marketing Brochure: "The Human Connection". **Sprint.** http://www.sprintbiz.com/wsg/products/operator_services.html. **HebCom.** http://www.hebcom.com. **InfoNXX.** http://infonxx.com. **McLeodUSA.** Conversation with company representative. **Frontier Communications.** http://www.frontiercorp.com/products/index.html. **CTI.** http://www.cticallcenter.com/operatorservices.htm. and http://www.cticallcenter.com/directoryassistance.htm. **Excell Agent Services.** http://207.87.27.10/forbes/97/0224/5904080a.htm. **InTeleServ.** http://www.inteleserv.com/articles_pr3apr98.htm. **Horizon Telecom.** http://www.horizontel.com/chilltel/opsvc/index.htm. **Teltrust, Inc.** http://www.teltrust-inc.com/CONTACTS/cntmn.html. **Metro One Telecommunications.** http://www.metroone.com.

Table 13: Total Revenue Growth of Selected Providers of Operator Services and Directory Assistance

SNET. http://www.sec.gov/Archives/edgar/data/92244/0000092244-98-000011.txt. and http://www.sec.gov/Archives/edgar/data/92244/0000092244-98-000002.txt. **Sprint.** http://www.hoovers.com/annuals/11560af.html. **HebCom.** http://www.sec.gov/Archives/edgar/data/22301/0000950159-99-000039.txt. **McLeodUSA.** Http://www.hoovers.com/annuals/51489af.html. **Frontier Communications.** http://www.hoovers.com/annuals/11281af.html. **CTI.** http://www.sec.gov/Archives/edgar/data/18926/0000018926-99-000005.txt. and http://www.sec.gov/Archives/edgar/data/18926/0000906280-99-000078.txt. **Horizon Telecom.** Conversation with company representative and excerpts from serveral financial documents. **Teltrust, Inc.** http://www.hoovers.com/annuals/56971af.html. **Metro One Telecommunications.** http://www.hoovers.com/annuals/514000af.html.

Table 14: Third-party Providers of SS7, Database and AIN Services

Illuminet. Http:www.illuminetss7.com/local. **SNET**. hppt://www.snet.com/network. **GTE Intelligent Network Services**. http://www.gteins.net. **BTI Telecom Services**. http://www.btitele.com/services/carrier. **TNSI Telecom Division Services**. Http://tnsi.com/prodserv. **NaviNet**. http://www.clec.com/latest/clecnewsbody.cfm. **Revcom**. www.revcom.net. **Targus Information Group**. Http://phonedata.com

Table 15: Total Revenue Growth of Selected Providers of SS7, Database, and AIN Services

Illuminet. 10K/Q Reports. **SNET**. 10K/Q Reports. **BTI Telcom Services**. 10K/Q Reports. **TNSI Telecom Services**. 10K/Q Reports of Transaction Network Services. **Navinet**. Online Annual Report. Http://www.cmgi.com/main/html.

Table 16: Total Revenue Growth of Selected CLECs That Use SS7 Alternatives

GST Pacific. http://www.gstcorp.com/products.html. **US LEC.** http:///www.uslec.com/

Table 17: Manufacturers of OSS/Gateway Solutions

Harris Communications. http://www.commprod.harris.com/test-mgmt/lts/105a.html. **Metasolv.** www.metasolv.com/products.htm. **Micromuse.** www.clec.com/latest/newproducsbody.cfm(23-Feb-1999). **Intelligent Electronics.** AEftia and IET Combine Services≅ from www.clec.com/latest/newproductsbody.cfm (13-Jan-1999). **Telcordia.** www.telcordia.com/solutions/operations/dualmode.html. **Ascend.** www.ascend.com/3404.html. **INRANGE**. www.gsnetworks.com/clect/index.html. **DSET**. From Telecoms OSS BSS and In News, 26-April-1999. **Eftia.** www.eftia.com/solutions/index.htm and www.paetec.com. **Wisor Telecom.** www.wisor.com/news1.html. **ACE*COM** www.acec.com/usa.htm. **ENA** From AEnterprise Network Applications and Talarian Announce Strategic Alliance to Integrate Products,≅ Press release. **PCR, Inc.** www.pcr.com/esys/modules.htm#operations. **IBM.** From Operational Service Support, Inner workings of Customer Migration. AICG deploys new OSS systems from IBM≅, www.clec.com/latest/oss99. **BEA Systems.** From ACovad selects OSS vendor≅, 2-Feb-1999, CLEC.com Press Release. **EDS.** From ABTI deploying new provisioning software and billing services≅, 07-May-1999 CLEC.com press release. **Telcordia/Nortel.** From ATelcordia and Nortel team to market OSS products, by Eric Boles, advertising supplement to CLEC.com, May, 1999.

Summary of Attachments:

Attachment A: Evolution of the CLEC Industry

Attachment B: State and Metropolitan Area Data Book

Attachment C: Remote Switching Map - 650 Miles

Attachment D: DLC Switching Map - 125 Miles

Attachment E: SONET Ring Topology (Transport)

Attachment F: Summary of Funding and Partnering Activities